THE

JOURNAL OF GAS LIGHTING.

PUBLISHED QUARTERLY,

WITH AN INTERMEDIATE SUPPLEMENT ON THE 10TH OF EACH INTERVENING MONTH.

No. 9.] LONDON, OCTOBER 10, 1849 [PRICE 1s.

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TO CORRESPONDENTS.

S. P. (Winchester.)—*The system of setting clay and iron retorts together under one arch, is the invention of Messrs. Lowe and Kirkham, and patented by them some years ago. Mr. Croll modified it by fixing the clay retorts in one arch, and then conducting the heat to another arch filled with iron retorts; but we believe Messrs. Lowe and Kirkham claim all combinations of clay and iron retorts heated by one fire, and that Mr. Croll takes a licence from them to use their invention. Your experience does not, therefore, apply in this case.*

"The Chevalier GUSTAVE RADLINSKI's" *friends (if he has any) should provide him with that necessary part of the attire of some of the inmates of Hanwell asylum called a strait waistcoat.*

"A THEORETICAL READER" *is informed that subsequent investigation has further confirmed us in the opinion expressed in our last number respecting the subject to which his letter refers.*

NOTICES.

All communications relative to the editing of the JOURNAL OF GAS LIGHTING, and orders for Advertisements, to be addressed to the Editor and Proprietor, THOMAS G. BARLOW, Civil Engineer, 32, Bucklersbury, London.

The Terms of Subscription are:—

Six Shillings per Annum for the Quarterly Journal and Monthly Supplement, payable in advance.

Advertisements are inserted at the rate of 5s. per six lines, and 6d. per line for all beyond, subject to the following discounts, if paid in advance:—

15 per cent. for 3 insertions.
25 ditto 6 ditto.
33⅓ ditto 12 ditto.

Subscribers who have not remitted the amount of their subscriptions are requested to do so, by Post-office order, to the Proprietor.

The Editor will be particularly obliged by his friends forwarding to him Notices of all Meetings, Trials, or Appeals which it may be interesting to the Gas World to have reported.

Circular to Gas Companies.

THE leading feature of the month is the complete registration of the GREAT CENTRAL GAS CONSUMERS' COMPANY of London, under the 7 and 8 Victoria, chapter 110, and the probability that, in some portion of the metropolis at least, the experiment will be tried of selling gas at 4s. We cannot but regret that our suggestions for placing the supply of this necessary article of life upon a sound basis have met with such feeble support among the more important companies, whose interests must be affected by the experiment about to be tried. Some may fancy themselves beyond all danger; but the wedge, when once entered, becomes irresistible, and the strongest must in the end yield to its influence. The energy of a new and progressive body—enthusiastic in its feelings, earnest in its exertions, and persevering in its agitation—must soon find an echo in quarters as yet considered secure against their consequences. We do not wish to express ourselves too despondingly on the subject, but we cannot conceal our conviction that a grave error has been committed, and an opportunity lost which might have placed the millions invested in the metropolitan gas works upon a secure basis. As it is, we see before us diminishing revenues, increasing expenses, and an ultimate loss of one-half of the capital invested. And we are not alone in our views. Every intelligent director and manager of the larger provincial gas works with whom we have conversed, have fully coincided with us, and highly approved of the suggestions we have from time to time promulgated on this subject. If they have been unheeded, the fault is not ours, but must rather be sought for in the petty jealousies which unfortunately interfere to prevent a cordial union among the several members of the gas body—jealousies unworthy of the great interest at stake, and, in our opinion, fatal in their consequences.

Dr. Fyfe, the professor of chemistry of the University of Aberdeen, has favoured us with a valuable paper in reply to some strictures of Mr. Wright, upon the doctor's published report on the comparative value of coal for the purposes of illumination. Many of our readers will no doubt have been struck with the low value assigned in all Dr. Fyfe's reports to Newcastle coal; and subsequent experiments have convinced him that he has underrated the value of the gas *now* made from this coal, to the extent of 89 per cent. We suspect that, at the period when the doctor made his previous experiments at Newcastle, the coal used at those works was the small slack, perhaps saturated with moisture, and hence yielding a gas of very inferior illuminating power. With regard to the more immediate subject of the controversy, we refrain from giving any opinion at present, till it is seen whether Mr. Wright has any further observations to make on the reply he has elicited from his worthy opponent.

Many of our subscribers have requested us to obtain for them the best information in our power respecting the production of gas from water in combination with carbonaceous bodies, and we direct their attention to an article on this subject in our present number. We never attached any importance to the project, knowing the impossibility of its competing, under any circumstances, with coal gas; but we were scarcely prepared for the astounding fact that the cost of *fuel* alone for its production nearly equalled the whole cost of coal and fuel for the manufacture of coal gas. We should also observe that, in the experiments upon which this report is founded, the gas was washed in the lime-water, so as to be deprived of its carbonic acid, which had deteriorated its illuminating power in other experiments. The 7280 cubic feet of gas was generated in thirty-one hours by a setting of two resin retorts and two water-decomposing retorts, occupying about the same space as a bed of five coal gas retorts, capable of producing 22,500 feet of gas within the same period. We apprehend, therefore, that the agitation on the subject will soon subside.

Communicated Articles.

ON THE COMPARATIVE ILLUMINATING POWER OF COAL GAS, IN REPLY TO THE REMARKS OF MR. WRIGHT.

BY ANDREW FYFE, M.D., &C., PROFESSOR OF CHEMISTRY, KING'S COLLEGE, UNIVERSITY ABERDEEN.

In a paper published in the JOURNAL OF GAS LIGHTING for August, Mr. Wright has made some observations in reference to

the method which I have followed for ascertaining the comparative value of gases, from different coals, for the purposes of illumination. After what I have already published regarding that method, I did not expect that its accuracy would now be called in question; and more particularly, that an attempt would be made to overturn the results of my numerous experiments by *reasoning*, while recourse could have been so easily had to experimental proof. I trust, however, that I shall be able to satisfy Mr. Wright that I have not committed a *lapsus*; and that the method which I recommended, upwards of twenty years ago, for ascertaining the illuminating power of coal gases, and on which I have since that time repeatedly published, is a correct one; consequently, that the statements I have made, not only in my last but also in former papers, are correct.

My method is to ascertain the amount of condensation by chlorine, and then, along with it, to take the consumpt under similar circumstances; or, which is the same thing, the time required for the consumpt of the same quantity—in other words, the *durability*. To this process Mr. Wright objects, that along with the condensation by chlorine I ought not to take the durability; because, if the condensation indicates the comparative amount of illuminating matter in the gases, their illuminating power will be in proportion to the quantity. This at first sight appears to be plausible, but it is not correct. He forgets that, independent of the quantity of illuminating matter, much depends also on the mode of consumpt, and, consequently, on the time required for burning that illuminating matter; and also whether or not it is perfectly or properly consumed. The researches of Christison and Turner have shown that the illuminating power of a gas may be high or low, according to the modes of burning it; and hence, I suspect, the reason for Mr. Wright calling in question the accuracy of my statements regarding the high value which I have assigned to the gases got from the parrot coals of Scotland. He has never been able, I presume, by the manner in which he operates, to make that illuminating power so great as I have stated; and therefore he asserts that my mode of proceeding is fallacious. Had Mr. Wright operated in the way in which, I think, he ought to have done, he would have got different results, and had he consulted my previous papers, he would have seen that I have not always trusted to the chlorine process, but that I have occasionally had recourse to the photometer test, and that I had then found the results by both processes to correspond with one another, or very nearly so.

I am aware that it has been brought forward by several as an objection to the chlorine process that, when a gas indicates a greater amount of condensation than another, the latter will require a longer time to consume it; and that thus it merely gives the light for a longer time. This, I presume, is Mr. Wright's argument: for instance, if one gas indicate 10 and another 20 by chlorine, and suppose that the former burns 1 foot per hour, and the latter only half a foot in the same time, and under similar circumstances; or, which is the same thing, that 1 foot of the former lasts one and 1 foot of the latter lasts two hours; then it is imagined that, as in one hour only 10 of the 20 of condensible matter escape, the same light will be given by both during the escape; and that, therefore, as the latter burns during twice the time, the illuminating power, —in other words, the value—is only twice that of the former; were it so, then, for equal consumpt in the same time, the illuminating power of all gases should be the same. It is well known that it is the reverse. There is no necessity, however, for *reasoning* on the subject; let us at once come to experimental proof; and first, I refer Mr. Wright to the results of trials which I published in the Journal of the Society of Arts for Scotland in 1842 (also Jamieson's Journal, same date). I commence with them, because they were conducted, not with the view of testing the accuracy of the chlorine process; therefore, if the results by it and by the photometer correspond, the proof of the accuracy of the former will be more satisfactory.

In the paper above alluded to the following table occurs. I copy only that part applicable to the present subject, and reverse the order.

Table of the comparative illuminating power of gas from different coals compared with that of a wax candle, taken as unity. The gas was consumed by a jet with aperture of $\frac{1}{35}$ of inch, and with a five-inch flame:—

Coals.	Ill. P. by Phot.	Cond. by Chlor.	Const. 1 ft. in min.	Coals.	Ill. P. by Phot.	Cond. by Chlor.	Const. 1 ft. in min.
Skaterig .	1·89	9·00	45·5	Monkland *a*	2·64	13·0	60·0
Marq. Loth. B	2·45	13·50	61·5	Ditto *b*	3· 9	19·0	74·0
Ditto A	2·70	12·75	57·5	Lesmahago D	3·35	16·12	63·7
Torryburn	2·07	13·0	57·5	Wemyss *a*	3·36	22·0	80·0
Lesmahago F	2·88	15·33	61·0	Ditto *b*	3·67	17·0	70·0
				Arniston *a*	3·57	16·5	67·0
				Ditto *b*	3·69	19·5	70·0

The following table shows the difference between the results by the photometer and by the chlorine process; the results are calculated from those given in the table above; taking, along with the light in the one case, and with the condensation by chlorine in the other, the durability also stated in the table (thus 9 : 13·5 :: 1 : 1·5 and 45·5 : 61·5 :: 1·5 : 2):—

Coals.	Ill. P. by Phot. 1 ft. = Candle.	Ill. P. by Chlor. 1 ft. = Candl	Difference.	Coals.	Ill. P. by Phot.	Ill. P. by Chlor.	Difference.
Skaterig	1·00	1·00	0·00	Monkland *a*	1·84	1·89	0·05
Marq. Loth. B	1·76	2·00	0·24	Ditto *b*	3·37	3·43	0·06
Ditto A	1·78	1·78	0·00	Lesmahago D	2·49	2·49	0·00
Torryburn	1·80	1·81	0·01	Wemyss *a*	3·00	2·89	0·11
Lesmahago F *a*	2·05	2·27	0·22	Ditto *b*	3.13	4·29	1·16
				Arniston *a*	2·79	2.71	0·03
				Ditto *b*	3·01	3.32	0·31

In the above the difference between the results by the two processes is very trifling, excepting in one or two instances; I will refer to these more particularly afterwards.

In trials which I have lately made, the results by the photometer and by the chlorine process, taking also durability into account, very nearly correspond. Thus, a gas from English caking coal by chlorine 5; durability, by a jet of $\frac{1}{35}$ and five-inch flame, 1 foot 45′. A gas from a Scottish parrot coal by chlorine 12·5; durability 57′.5; then 5 : 12·5 :: 1 : 2·5 and 45 : 57·5 :: 2·5 : 3·19. By the photometer, the lights from the five-inch flame were in one trial as 1 to 2·56, in another 2·58; then as 45 : 57·5 :: 2·58 : 3·3. Dif. 0·11.

Again, a gas from English coal by chlorine 6·5; durability 50′·7. Another from a mixture of Scottish parrot by chlorine 11·5; durability 65′. By the chlorine process the illuminating power will be as 1 to 2·24. By the photometer they were for equal consumpts 1 to 2·02. Dif. 0·22.

Comparing a gas from the mixture of Scottish parrot with one from a very fine parrot coal, which indicated 23 by chlorine, and durability 80, the illuminating power by the chlorine process will be 1 to 2·46. By the photometer they were for equal consumpts as 1 to 2·26. Dif. 0·2.

Numerous other instances might be given. I trust the above are sufficient to show that the results afforded by the chlorine process are accurate; consequently that I have not committed a *lapsus*, as Mr. Wright asserts, in taking durability into account along with condensation by chlorine, in estimating the illuminating power *for the consumpt of equal quantities*.

While I thus maintain that the process I have practised is correct, I must at the same time admit that the results do not always correspond; but, in my opinion, the exceptions, instead of showing the inaccuracy of the method, rather tend to prove its accuracy.

In the cases to which I now allude the gases are of very high illuminating power, and are contrasted with one the illuminating power of which is far beneath them. Thus, take the gas from English coal above referred to, and compare it with the last-mentioned gas; the chlorine and durability of the former are 6·5 and 50′·7, of the latter 23 and 80′; then 6·5 : 23 :: 1 : 3·53, and 50·7 : 80 :: 3·53 : 5·57. By the photometer the lights are as 1 to 4·57. Dif. 1·0.

Now in these, as in the other instances that have occurred, in which the results by the two processes do not correspond, not only is the illuminating power, as indicated by the chlorine process, always beyond those given by the photometer, but it is only when the gas is one that is rich in illuminating matter that the light by combustion does not come up to the indication by the chlorine; there must, therefore, be some source of failure which causes the results by the photometer to be below those indicated by the other process. We can, I think, account for this by the difficulty we experience in consuming the richer gases, so as to make them give the light that they ought to give, when properly burned.

With the view of ascertaining whether I was right in this opinion, two gases were mixed, as nearly as possible in equal proportions; viz., 30 feet of the one with 30 of the other. The condensation by chlorine in the former was 5·5, in the latter 23; the durability of the former 50′.40″; of the latter 80′.

By the photometer the illuminating power for equal consumpts, in the same time, was as 1 to 4.57. By the chlorine process they should be 1 and 5·57 (6·5 :: 23 :: 1 : 3·53, and 50′.40″ : 80′ :: 3·53 : 5·57). Dif. 1·0.

After waiting for some time, to allow perfect mixture, the condensation by chlorine amounted to 17, and the durability to 76′.40″. This was beyond what I expected; owing, perhaps, to unequal pressures on the gasometers having occasioned too much of the richer gas to be used. By the photometer the illuminating power was 3·22; now, by the chlorine process it should be 3·93 (6·5 : 17 :: 1 : 2·61, and 50′.40″ : 76′.40″ :: 2·61 : 3·93). Dif. 0·71.

Comparing the richer with the poorer gas, the illuminating power by the photometer was 1 to 4·57; but by the chlorine process it should be 5·57. Dif. 1. In the case of the mixture in which the matter condensible by chlorine was reduced, the difference between the results was only 0·71.

An additional quantity of the poorer gas was thrown into the mixture to diminish still further the condensible matter, and the

mixture was kept for three days; the condensation by chlorine then amounted to 13, the durability to 73′.20″.

By the photometer the illuminating power was 2·52; by the chlorine process it should be 2·89, thus 6·5 : 13 :: 1 : 2, and 50′.40″ : 73′.20″ :: 2 : 2·89. Dif. 0·37.

In this last instance the difference between the results by the photometer and by the chlorine is still further reduced; evidently, I think, proving that the defect does not depend on any inaccuracy in the chlorine process, but on the combustion of gases, rich in illuminating matter, not being so conducted as to make them give forth the light that they should give. With these exceptions, then, I think that we are warranted in putting implicit confidence in the chlorine process. In cases in which the gases are rich in illuminating matter, the illuminating power indicated by the photometer is below what it ought to be.

From what has now been stated, it may be asked, how does it happen that my results so far exceed those stated by other experimenters—chiefly those in England? To this I answer, that my results are not too high, but that theirs are too low; because the methods they practise in ascertaining the illuminating power, even when using the photometer, are defective; and, in my opinion, none more so than that practiced by Mr. Wright. In the first place, he uses a jet with an aperture of $\frac{1}{8}$th of an inch in diameter. Now, it must, I think, be admitted that the gas cannot by this mode be consumed to advantage for affording light. Mr. W. allows this, but then he says that, "though the gas is not consumed to great advantage, it shows the *relative* value of gases better." I do not admit this; and if he will try it experimentally he will find that it does not.

It has been satisfactorily proved by the experiments of Christison and Turner, and also by those recorded by myself,—indeed it must be well known to those engaged in inquiries on the value of gases,—that the illuminating power depends not only on the quantity of illuminating matter which they contain, but also on the mode of burning them—chiefly *the size of the aperture*. A poor gas requires a larger aperture than a rich one; and, accordingly, the poorer gas from English coal may be burnt advantageously with an aperture of $\frac{1}{8}$th of an inch; but not so the richer gases got from Scottish parrot coals; hence, in all probability, one reason for the very low value assigned by Mr. Wright to the latter, viz., 2·3 compared to the English as 1, and that English apparently a very indifferent gas.

Again, Mr. Wright not only uses the large aperture, but he adjusts the flames so as to give the same light, or to burn the same quantity. His method consists "in burning one volume of each gas in the same length of time;" then the values are as the lights ascertained by the photometer; or "two flames from each gas (*one* from each) may be burned of the same intensity;" and then the values are as the times for the consumpt of equal volumes. To both of these modes of proceeding I decidedly object; because they do not give the true values. It is well known that the lower the flame the less advantageously is the gas consumed. Now, as a rich gas will require the flame to be lowered much more than a poorer one, to cause it either to give the same light, or to make it burn the same quantity, consequently the former must be burned to much greater disadvantage than the latter; and, accordingly, its illuminating power, compared with that of the latter, will be made much lower than it ought to be.

But Mr. Wright is not single in this respect. I observe that it is the method generally practised by other experimenters in England, even where argands are used. The common practice, so far as I understand it, by reading the accounts given of their results, is to consume the gas with *such a height of flame, as will make the lights correspond* either with that of a wax candle, or with those from the gases contrasted with each other. Now, by this neither of the gases may be consumed advantageously; or it may happen that, if the poorer gas requires a flame of from two to three inches, it may be profitably burned, while the richer gas may require a flame of only one inch or so, according to its quality, and accordingly be consumed *to very great disadvantage*.

There is another circumstance to which sufficient attention has not been paid when using the photometer, and especially when contrasting a poor with a rich gas. I mean the kind of burner and the dimensions of the apertures; because one gas is more advantageously burned by one kind, and another by another.

In proof of this I refer to the paper published by Christison and Turner (Jamieson Journal, 1825), and also to my own paper, 1840, &c. I may also give the results of experiments made lately with gases of different qualities and with different burners:—

Gas from Scottish Parrot Coal.

Argand, 56 holes, consuming	3·8 ft.	per hour	— 1 ft. =	3·69	candles.
	4·4	„	„	4·54	„
Do., 72 holes	6·5	„	„	5·53	„
	4·2	„	„	4·20	„

In these trials not only do the results differ with different burners, but they also vary with the same burner according to the quantity consumed; the greater the quantity, up to a certain extent, the greater is the comparative amount of light, for the consumpt of equal volumes.

Gas from Scottish Parrot Coal.

Jet, aperture $\frac{1}{15}$ of inch	— 1 ft. =	4·08	candles.		
Jet, „ $\frac{1}{10}$	„	4·23	„		
Argand, 72 holes,	7 ft.	per hour	— 1 ft. =	5.57	candles.
„	5	„	„	6·60	„
„	3·3	„	„	3·40	„
Argand, 42 holes,	3·3	„	„	5·40	„
„	4	„	„	6·87	„

Gas from English Coal.

Jet, $\frac{1}{15}$ — 1 ft. = 2·12 candles.
Jet, $\frac{1}{10}$ „ 1·36 „

Gas from Scottish Parrot Coal.

Argand, 56 holes,	2·7 ft.	per hour	— 1 ft. =	9·26	candles.
„	3	„	„	12·50	„
Argand, 72 holes,	4·2	„	„	8·10	„
„	5·5	„	„	8·27	„
„	6	„	„	9·30	„

In the above the jet with the small aperture consumes the Scottish gas more advantageously than the larger one does. With the English gas it is the reverse. With Scottish gas the argand 42 is the best. I did not find it to be so with the English: with it argand 72 was the best.

It is evident, from what has now been stated, that, in using the photometer as the test of the illuminating power, it does not do to use one kind of burner in all the trials; the gases must be burned under a variety of circumstances, to find out the most profitable mode of consumpt for each; and, having done so, then the light afforded by the one, *burning most advantageously*, must be contrasted with that from the other, also *burned in the most profitable way*. Keeping this in view, let us now see what the comparative value of the gases is. According to Mr. Wright, the English gas he used as his standard gave for the consumpt of 1 foot in one hour the light of 1 candle. By a similar mode of operating, but using a jet of $\frac{1}{15}$ of inch, I have found the light of a gas from a superior kind of English coal to be 1·5 and 1·7 candle per foot an hour; when using the argand the light amounted to 2·73 candles per foot in the same time.

In conducting these trials I had recourse to the Bunsen photometer, with a wax candle (short six), as the standard source of light behind, placed at the distance of four inches. The gas-burner was then placed before the screen, and moved till the spot disappeared; of course the distance indicated the lights. This was repeated with different burners, and with different heights of flame, till the most advantageous mode of consumpt was discovered.

With the best English gas that I have yet obtained, and the most profitable mode of consumpt, the distance at which the spot disappeared was 15·5 inches; the quantity of gas consumed being 5·5 feet per hour; then for candles $4 \times 4 = 16$, and for gas $15{\cdot}5 \times 15{\cdot}5 = 240 \div 16 = 15. \div 5{\cdot}5 = 2{\cdot}73$ — 1 foot of this gas = 2·73 candles.

This result is beyond what I obtained with English gas on former occasions. It was got from coal now in use at some of the gas-works in London:* one ton yielded 9746 feet of gas of specific gravity ·555. The condensation by chlorine was 6·5; one foot with jet $\frac{1}{15}$ and 5-inch flame burned 50′.40″. In my paper published in No. 6 of the Gas Journal, the English gas mentioned indicated by chlorine 4·33, was of durability 50′.30″ by a 4-inch flame, that is about 40 by 5-inch flame. Now, by the chlorine process of estimating the values, 4·33 : 6·5 :: 1 : 1·5 and 40 : 50·40 :: 1·5 : 1·89, or very nearly so; consequently the value of the English gas now used is 1·89 to that of the other as 1. It is necessary to keep this in recollection in estimating the value of the gases as given in my paper. The greater illuminating power of the English gas now used will, of course, reduce their value as compared with it; not that the method of ascertaining their value, which I practised, is inaccurate, but merely because the coals are now contrasted with a gas of higher illuminating power than that with which they were formerly compared.

Considering the value of the English gas now used as 1·89 compared to the other English gas as 1, then, as compared with it, the value of the English parrot coal gases will be very nearly the same as it; because, though they have a greater quantity of matter condensible by chlorine, viz., 7·5, yet their durability is less, in the ratio of 42 to 50, or nearly so, for a 5-inch jet flame.

The average of gas from Scottish parrot coal will, instead of 5·46, be 2·87; and of the Lesmahago gas, instead of 6·6, will be reduced to 3·49: compared with this English gas as 1· (1·89 : 6·6 :: 1 : 3·49).

The value of the gases mentioned in my paper in 1842, when compared with the gas used by Mr. Wright as his standard, and equal to 1 candle, when burning 1 foot per hour, will be:—

Coals.	Candles.	Coals.	Candles.
English	1·00	Monkland, *a.*	2·64
Skaterig	1·43	Ditto *b.*	4·81
M. Loth. B.	2·51	Wemyss, *a.*	4·48
Ditto A.	2·56	Ditto *b.*	4·28
Torryburn	2·59	Arniston, *a.*	3.98
Lesmahago, F.	2·90	Ditto *b.*	4·30
Ditto D.	3·51		

* New Pelton and South Peareth.

In the above, I have considered the illuminating power of the English gas to be, as given by Mr. Wright, equal to 1 candle per foot. I have found my English gas to be equal, on an average, to 1·6 candle per foot, when consumed by the jet. This may be owing either to Mr. Wright burning the gas by the large aperture, and not doing justice to it, or to the gas he has used being of inferior quality to mine; perhaps to both. That it may have been in a great measure owing to the latter would appear from the great difference in the specific gravity, which with his gas was only ·360, while with mine it was ·555. Besides, Mr. Wright, in a subsequent paper, has alluded to a change in the quality of the gas, which had been raised from 1 to 1·36 candle, during the time he was carrying on his experiments.

Assuming the English gas, when burned by the jet, as equal to 1·6 candle per foot in the hour, then the value of the gases given in my paper, 1842, will be as follows:—

Coals.	1 Foot = Candles.	Coals.	Candles.
English	1.00	Monkland, *a*. . . .	1·62
Skaterig	0·94	Ditto *b*. . . .	3·00
M. Loth, B.	1·56	Wemyss, *a*. . . .	2·80
Ditto A.	1·60	Ditto *b*.	2·67
Torryburn	1·62	Arniston, *a*. . . .	2·49
Lesmahago, F. . . .	1·82	Ditto *b*. . . .	2·69
Ditto D. . . .	2·19		

While I have thus reduced the comparative value of the Scottish gases, formerly reported on, it must be borne in mind that it is because I now contrast them with a gas of higher value than was formerly used, in the ratio of 1·89 to 1. Having done so, I am now entitled to advert to gases, which I have lately obtained from Scottish parrot coals, of superior quality to those formerly employed, and which will bear me out in the statements I have made, regarding the high value of the Scottish parrot coals, for affording light by the combustion of the gases obtained from them.

The first of these to which I shall allude is a Lesmahago coal from the pits of the Duke of Hamilton.

The quantity of gas afforded from a ton was 10,420 feet. The condensation by chlorine amounted to 23. 1 foot with jet $\frac{1}{5}$, and with a 5-inch flame, burned 80 minutes; when consumed by an argand with 56 apertures, of $\frac{1}{25}$ of an inch in diameter, to the extent of 3 feet per hour, it gave the light of 37·5 candles, which ÷ by 3 = 12·5 per foot.

I have given my English gas, when consumed most advantageously, as = 2·73 and 12·5 ÷ 2·73 = 4·57. The quantity of gas evolved being 10,420 from the one, and 9746 from the other, then the value *of the coals* is 9746 : 10,420 : : 4·57 : 4·88; thus making the value of this Lesmahago coal, *by the photometer test*, 4·88 to the best English caking coal that I have tried.

I have been told that the gas manufactured at the gas-works in London from the same English coal, when consumed to the extent of 5 feet per hour, by an argand burner, gives the light of from 12 to 14 candles, say on an average 13, which ÷ by 5 = 2·6 per foot, a very close approximation to my result, 2·73.

I have given the value of the Lesmahago gas by the candle test as 4·57 to the English as 1; by the chlorine test it ought to be higher, thus 6·5 : 23 : : 1 : 3·53 and 50·40 : 80 : : 3·53 : 5·57. Dif. 1. I have no doubt that, were the Lesmahago gas consumed to the greatest advantage, the chlorine test would be the accurate indication of the comparative illuminating power; but take it by the candle test, and as it may be used by the public, it is, foot for foot, 4·57 to the other as 1; consequently, to light an apartment to the same extent, less than one-fourth of the Lesmahago gas is necessary than is required of the English gas.

In another trial with a Lesmahago coal, gas was obtained which indicated 19 by chlorine; durability 79′.50″. When consumed by an argand, to the extent of 3 feet per hour, the light amounted to that of 25 candles, which ÷ 3 = 8·33, which ÷ 2·73 = 3·06 to the English as 1.

I trust that, from what has now been said, I have proved the accuracy of my mode of proceeding by the chlorine process, and that, along with the amount of condensation, I am entitled to take in durability. We may, therefore, confide in it as an accurate method of ascertaining the practical comparative value of gases, particularly of those in which the illuminating power is not very high; for instance, when the condensation by chlorine is not above 16 or 17 per cent; beyond this it exceeds the value assigned by the modes of combustion hitherto in practice. For the value of the gases with which towns are at present supplied, it may be considered as perfectly accurate. I trust, also, that I have proved the great superiority of the gases obtained from Scottish parrot coals, and that consequently these coals, even by the photometer test, far surpass the English coals for affording light by the combustion of their gases.

In thus replying to the remarks of Mr. Wright, and in animadverting on the mode of operating practised by others, I hope that I have not said anything offensive. I certainly have not intended to do so. I hope that my remarks will be received with the spirit in which they are given. When animadversions are made and received in this way the more we animadvert the better, for then we are more likely to arrive at the truth. And now permit me to say that I feel indebted to Mr. Wright for his observations, and for the manner in which they have been made. I trust that benefit will result from our combined exertions, and that experimenters will be brought to a uniform mode of ascertaining the illuminating power of gases, and consequently of the value of the coals used in their manufacture. I have all along trusted to the chlorine process, because it gives us a method of fixing numerically the value of the gases. Perhaps the comparison by candles is more easily understood *commercially*; and, if so, I have no objection to abandon the former and have recourse to the latter, provided experimenters will fix on a standard source of light for comparison, and will also agree to the proposal already made, that each gas be consumed by a method previously found to be the most advantageous for it; because it will not do for those accustomed to experiment with English gas to insist on using argands, adjusting the light afforded by them to the standard, and then to burn the Scottish gases with the same burner, and lower the flame to make it give the same light as the other; or to make the gases burn the same quantity in the same time, and to mark the lights. This is placing the Scottish gases at a great disadvantage. Let each experimenter use the burner which he has found to be best for the combustion of the gas with which he is operating, and then let him ascertain the light afforded by the consumption of 1 foot per hour, compared with the source of light previously fixed on by general consent as the standard.

With regard to the standard light, I prefer a wax to a spermaceti candle. I find that it is more uniform in its combustion, and consequently more steady in the emission of light. I generally use a short six, because, owing to the size of the wick, it varies less than the others. Supposing a short six wax candle to be preferred, and that it is placed behind the Bunsen screen, at the distance of 3·165 inches from it, the square of which is 10, then the square of the distance at which the gas-burner causes the spot to disappear, divided by 10 and then by the quantity of gas consumed, will at once give the comparative value, foot for foot, consumed in the same time. Perhaps the candle, placed at the distance of 10 feet behind the screen, would in some cases be more convenient.

Before concluding I have to allude to remarks made by Mr. Wright regarding ascertaining the illuminating power by the specific gravity. He says that "the illuminating power of gas is directly as the specific gravity, but in an increasing ratio." Ought he not, along with specific gravity, also to take in *durability*, as his increasing ratio? in fact, to do what he finds fault with me for doing, in using the chlorine test. It is well known that gas of greater specific gravity requires a longer time than one of less specific gravity for the consumpt of the same volume. Perhaps he will find that the law to which I have referred in my paper, viz., the escapes being inversely as the square roots of the gravities, or the times for equal escapes being as the square roots of the gravities, will aid him in coming at a better method of determining the illuminating power by the specific gravity. I would strongly recommend him to turn his attention to this, not that I put much faith in the test by specific gravity; but, if it is to be trusted to as an indication of the quantity of illuminating matter, the law of escape indicating the time which that matter requires for combustion, in my opinion, should be also taken into account.

There is only one other circumstance to which I would briefly advert: I mean the imperfect combustion of gases rich in illuminating matter. It has been shown that with them the candle test does not come up to what it should be as indicated by the chlorine process. This suggests the propriety of endeavouring to find out an improved method of consuming them, so as to burn to advantage the illuminating matter which they contain. In the mean time gas manufacturers, especially in Scotland, may find it to the advantage of their customers to mix with the richer gases those of inferior quality, with the view of reducing the amount of illuminating matter, and thus of bringing it down to the state in which the whole of it can be consumed advantageously; for instance, to have the matter condensible by chlorine not to exceed 14 or 15 per cent., which is the amount in the gases generally supplied to the towns in Scotland.

* If we are to put any confidence in the specific gravity as an indication of the illuminating power, surely Mr. Wright's gas was of very inferior quality. I have always understood that the specific gravity of gas from English coal is beyond 400. The gas in Newcastle was on an average ·420.

WATER GAS.

We have at length some facts before us, as to the value of this twin-sister of Messrs. Owen and Reece's Peat scheme. Both projects were ushered into being, with the same flourish of professional puffery, and attracted a large share of public attention, their success being destined to change the fate of an immense mass of capital, and beggar or enrich thousands. Lord Ashley and the O'Gorman Mahon have not done more in the line of the puff parliamentary, than has the faithful army of ignorant enthusiasts, who (in defiance of the known laws of nature and science) saw in the new project a brilliant harvest, to ensure the early ripening of which they resorted to the puff editorial. A saving of 75 per cent. in the price of any article, more especially of one in such universal consumption as gas, is a tempting bait; and every editor

is not presumed to be chemist enough to judge of a project involving such abstruse questions as the composition of water, the mode of its decomposition, and the new combinations resulting therefrom; and, as it is a fact that no member could be found in the House of Commons capable of exposing the fallacies of the scheme of Lord Ashley's *protégé*, we can scarcely wonder that commissioners of lighting, and town-councillors, should have been found patronizing the new invention, nor that its projector should be gravely cutting short a lecture, and making his bow to a New Athenian audience, on the plea that his presence had been commanded in the great metropolis, by one of its largest companies, to *débuter* on the metropolitan stage,—with what success this took place we shall presently show.

The parallel between the two projects holds good in many ways: both were conceived in the most profound ignorance of the experience of the last quarter of a century; and, while the one would reconduct us to the ages preceding the experiments of Daniell, Donovan, and Lowe, and the dearly-bought attempts of Liverpool, Bristol, Hull, Taunton, and numberless other cities, to sustain a hopeless rivalry with their more powerful antagonist—c al gas, the advocates of the other were equally unmindful of the thousands which had vanished on Dartmoor, in spite of the superior intelligence which had guided those operations, and the notoriety which had attended their failure. The water-gas scheme has had its trial, and the time is now come when the public should have some impartial information as to the results and prospects.

When the project first came before us, it purported to have for object the utilizing of coal tar, by decomposing it in conjunction with water, and applying the resulting gases to illumination. Such an invention seemed to us a plain and legitimate one, inasmuch as the carbonaceous material proposed to be used, was one of small value for other purposes, and the success of any mode by which it could be beneficially converted into a saleable product, would be hailed with acclamation, and amply reward its inventor. We knew by experience that coal tar of the value, in London, of 1s. 3d., could be so treated as to yield 1000 feet of gas superior to the gas from Newcastle coals, but that all experiments had hitherto failed, from the mechanical difficulties attending the introduction of the material into the retort. The addition of hydrogen we looked upon as the vehicle for reducing this rich gas to the same standard as the ordinary Newcastle coal gas, and thus rendering it commercially of the same value; not doubting but that due precaution would be taken to produce the hydrogen in a pure state, and free from its accompanying oxygen in any form. Our correspondent Mr. Graham embodied our views on this subject tolerably accurately in a letter inserted in the May number of this Journal, and we had some expectation that the inventor would have profited by the hints there given. We presume, however, that the difficulties which had arrested others, also presented themselves to him; for we quickly hear of his abandoning coal tar, and resorting to Stockholm tar, fat, oil, and, lastly, resin; and, finally, the invention resolves itself into one for diluting the rich and illuminative gas from resin, with non-illuminating hydrogen and carbonic acid, and the more subtle carbonic oxide.

Twenty-five years since, the late talented and ever-to-be-regretted Professor Daniell constructed an apparatus for producing resin gas, as superior in its manipulation and results to the one now under investigation, as the inventions of a master-mind invariably are, to the abortions of ignorant presumption. Daniell produced, with certain regularity, from one pound of resin, at least 9 feet of gas, 85 per cent. superior in illuminating power to Newcastle coal gas. In New York, Boston, Frankfort, and a few other cities, we see, even in the present day, the results obtained by Daniell fully borne out, and in some cases slightly improved upon; whilst in our own country we find an exploded and abandoned system, which has been commercially a failure in consequence of the cheapness of other materials, and till lately extinct, again revived with sundry retrograde modifications, and reappearing on the scene, working miracles, under the auspices of its new patrons. Hurrying about here and there, they sustained a sort of ubiquitous existence, attending numberless meetings of town councils and commissioners, delivering long and not very intelligible lectures, snubbing inconvenient questioners with smart replies, and making large demands on the faith of their hearers. The promises held out were, gas at 1s. 3d. per 1000 feet, good dividends, universal contentment and satisfaction,—prospects equalled only by Mr. Bovill's promise to "*tickle*" gas up from Wales for 3d. per 1000 feet; of which scheme, by-the-by, we now hear nothing more.

Having thus put our readers in possession of an outline of the antecedents of the proposed new mode of making gas for artificial illumination, let us examine into its details and the rationale of its operation. And here we purpose to discard as much as possible any investigation into the *chemical* questions involved in it, but to confine ourselves to its *commercial* bearing. This necessarily calls upon us for some inquiry into the relative costs and values of coal and resin gases, as the whole question hangs upon the practicability of producing the latter at a cost which will allow it to be sold, when diluted with hydrogen, at a price which shall place it upon a par in quality and value for artificial illumination with coal gas. Let us take the metropolis as the field where the experiment is to be tried.

At the present time a ton of Newcastle coal may be reckoned to cost 16s., and the products left, after providing the fuel requisite for distillation, will return 8s. 3d. out of the first cost, leaving 7s. 9d. as the value of the materials for producing 9250 cubic feet of gas, of a certain standard quality which we will call unity. The cost is, therefore, 10·5d. per 1000 feet for materials, independent of all the other expenses of fabrication.

The like amount of 7s. 9d. will purchase 290lb. of resin, which, when distilled under the most advantageous circumstances, will yield 2610 cubic feet of gas, the value of which in illuminating power being 1·85, as compared with the standard, is equal to 4828 cubic feet of coal gas; but, as 10 bushels of coke are further required as fuel, 2s. 11d. must be added to the 7s. 9d., forming together 10s. 8d. as the total cost of the corresponding materials for producing the equivalent of 4828 cubic feet of coal gas; being at the rate of 2s. 2·5d. per 1000 feet, which is 250 per cent. more than the cost of the materials for producing an equal quantum of light from coal.

As the other expenses of labour, &c., are greater to convert resin into gas, than coal into gas, it scarcely excites surprise that Dr. Ure, writing ten years since, should thus dismiss the subject in his "Dictionary of Arts and Manufactures," article "Resin Gas":

"I have introduced this manufacturing project, not as a pattern to imitate, but as an example to deter: as affording a very instructive lesson of the danger of rushing headlong into most extensive enterprises, without fully verifying, upon a moderate scale, the probability of their ultimate success. The capital, labour, and time annually wasted upon visionary schemes of this sort, got up by chamber chemists, are incalculably great. No more essential service could be rendered to the cause of productive industry, than to unmask the thousand-and-one chemical inventions which disgrace our list of patents during the last thirty years. These remarks have been suggested by the circumstance that £50,000 were squandered upon the resin-gas concern,—a fact communicated to me by an eminent capitalist, who was induced by fallacious statements to embark largely in the speculation. Had £100 been employed beforehand, by a dispassionate practical man, in making judicious trials and in calculating the chances of eventual profit and loss, it would have been demonstrated as clear as noonday, *that resin could never compete with pitcoal in the production of gas light.* Whatever ignorantly was expended in getting up the following apparatus may be regarded as an additional *ignis fatuus* to mislead the public, and divert their thoughts from the abyss that lay before them. The main preliminary to be settled in all new undertakings is, the soundness of the principle. By neglecting this point, projectors perpetually realize the expiatory fable of the Danaïdes."

Resin gas differs but little in its illuminating power from the gas produced by some of the Scotch cannel coals, as the following analysis of the respective materials will show:—

Resin.		Cannel Coal.	
Carbon	73·60	Carbon	72·22
Hydrogen	12·90	Hydrogen ..	3·93
Oxygen	19·50	Oxgen	20·05
		Azote	2·8
	100·00		100·00

Any process, therefore, for increasing the *bulk* of resin gas by diluting it with hydrogen, may be applied with equal and even greater reason to cannel coal gas, in which it will be seen that hydrogen is wanting to ensure the effective combustion of the large excess of carbon. Accordingly we find that, though the manufacture of resin gas had been abandoned as a perfect failure, yet the subject of hydrogenating the richer carburetted hydrogens produced from coal had not been also abandoned, but that several patents were the results of experiments on the subject. In one of them, granted in 1839 to Mr. E. O. Manby, we find the germ of Mr. White's patent of the 26th ult. (described in our present number), but with this difference, that Mr. Manby proposed to use steam generated in an independent boiler, and raised to a high temperature before being admitted into the decomposing retort; whereas Mr. White prefers to make use of water, which is converted into steam, and then decomposed in the same vessel. Of the superiority of the process of 1839 over that of 1849 there cannot be two opinions.

Mr. Manby claims generally, "the manufacturing of gas for the purpose of illumination, by passing steam into a retort or closed vessel containing anthracite, or stone coal, or culm, charcoal, coke, or bituminous coal, heated to the temperature described in the specification." The apparatus in which this can be effected is described thus:—"A cylindrical retort about eight or ten inches in diameter, placed vertically and with its lower end curved outwards to facilitate the discharge of its contents; this end is furnished with a lid or cover fitted in the usual way in which covers are fitted to gas retorts. The steam is supplied to each retort from a boiler by means of one main pipe, from which smaller pipes lead to each retort. This smaller pipe becomes heated to a considerable temperature. This pipe is furnished with a cock or valve, from whence it enters the retort at the lower extremity through the admission pipe. The retort is just heated to a lively red heat the same as the distillation of gas from coals, then quickly charged with the materials to be used for producing gas; and the heat is continued the same during the operation as is usual with retorts in the common manufacture of gas. Some minutes after the retort is charged and closed the steam is let in; the quantity at first let in must be very small, particularly when using anthracite or other matter containing a large portion of carbon. A small test burner should be employed, and,

if the illuminating power of the gas decreases, the quantity of steam entering the retort should be lessened. If much tar shows itself at the test burner or elsewhere, the quantity of steam must be increased, as well as the heat, as the greatest part of the generated tar or bituminous materials ought to form under the co-operation of steam, gas or gases having illuminating power. It is obvious that the principle of the invention does not depend on the particular form, size, or position of the retorts or closed vessels in which the gas is generated, or of the boiler supplying the steam, or of the other apparatus; these may be varied to a very great extent at pleasure, and must be proportioned in size to the quantity of gas intended to be made."

It is to be regretted that the system above described should have found no patron to give it a fair trial; for, though it has had many imitators, we doubt whether any of them have improved upon it, and some of them are mere plagiarists. There can be no question but that it offers a large field, rich in future discoveries to the sagacious and intelligent explorer, and as yet but little trodden.

The theory of augmenting the bulk of the gases produced by the decomposition of coal by the addition of water or steam has, however, been recently experimented upon by eminent chemists, and from an unpublished report of two of the most distinguished men of the day we extract the following passages :—

"Our attention was especially directed to the influence of the vapour of water, sent into the charged retort at a bright-red heat, upon the quantity and quality of the gas derived from different kinds of coal.

"The quantity of coal operated upon in each experiment was 168 lb.; and 11¼ lb. of water was converted into vapour, and transmitted over a body of coke kept at a bright-red heat, and equal in bulk to the charge of coal employed.

"The following is a tabular view of the results of these experiments :—

Qualities of Coal.	Cubic feet of gas produced by each ton of coal.	Specific gravity of gas.	Illuminating power in sperm candles, consuming 132 grains per hour.
Small	10,133	0·374	3 to 4
Ditto	11,360	0·375	2·5
Peareth ..	10,173	0·386	4·75
Ramsay's Cannel	12,586	0·414	7·

"In all the above experiments the illuminating power is calculated upon a consumption of 5 cubic feet per hour in an argand burner of 15 holes. Fifteen gallons of water, the quantity we were directed to use in the form of steam for each ton of coal, would, if converted into pure hydrogen and carbonic oxide gases, yield 3134 cubic feet of hydrogen, and 3134 cubic feet of carbonic oxide; so that upon this assumption the ton of coal, yielding on an average 9000 cubic feet of coal gas, would be increased to 15,268 cubic feet, supposing all the steam to be decomposed and resolved into those gases. But, if it be assumed that the hydrogen is converted into light carburetted hydrogen, in that case the bulk of the hydrogen would be diminished one half, 3134 cubic feet of hydrogen being condensed by combination with carbon into 1567 cubic feet; so that the 9000 cubic feet of coal gas would be increased in that case to 13,701 cubic feet. But it is evident from the above experiments that a large proportion of the water must escape decomposition, inasmuch as the volume of gas actually produced falls far short of this estimate. On the other hand, it is also obvious that the increase of bulk actually sustained by the gas is attended by a great diminution of specific gravity and illuminating power; and that, if the whole of the water had been decomposed, the illuminating power would have fallen to a much greater extent; *so that it is quite obvious that in proportion as the quantity of gas is increased by the decomposition of steam, its quality is proportionately diminished.*"

To results so conclusive we have nothing to add, further than to direct attention to the fact that an augmentation of from 10 to 15 per cent. in bulk, appears to have been attended with a decrease of 60 per cent. in quality.

Instead of coal, Mr. White uses resin, without, however, producing any considerable change in the results, as the following experiments, which have been partly conducted under his superintendence at one of the metropolitan gas works during the last month, will testify. It is to be regretted, however, that the quantity of water used, as well as the specific gravity and illuminating power of the gas, were not accurately noted; but still they afford ample evidence that the principles laid down in the above report apply in this case also.

First Experiment.

Resin	112 lb.
6 gallons of oil	48
1500 cubic inches of mixed oil and resin left from previous trials	55
4 bushels of charcoal.	
	215 lb. yielded 2800

cubic feet of gas, equal to coal gas, in 9 hours' distillation.

Second Experiment.

Resin	158 lb.
6 gallons or oil	48
1 bushel of charcoal.	
	206 lb. yielded 2000 feet

of gas in 10 hours.

Third Experiment.

Resin	168 lb.
1 bushel of charcoal.	
	168 lb. yielded 2480 feet

of gas in 12 hours.

We thus find that 589 lb. of oil and resin, decomposed in combination with water, yielded 7280 cubic feet of gas of the same value as coal gas. Let us now see what the materials for producing this quantity have cost :—

	£	s.	d.
468 lb. of resin at 3s. per cwt.	0	9	7
15 gallons of oil, equal to 135 lb. of resin	0	3	8*
6 bushels of charcoal, of which 4 remained at the termination of the experiments, leaving 2 bushels to be charged, at 9d.	0	1	6
20½ bushels of coke as fuel, at 3½d.	0	6	0
	£1	0	9

which sum, divided by 7280, gives 2s. 10·2d. as the cost of materials for producing 1000 cubic feet of mixed water and resin gas, equal in quality to coal gas, but 55 per cent. inferior to pure resin gas.

The relative costs of the materials for producing *equal quantities of light* are, consequently, as follows :—

	s.	d.
Newcastle coal	0	10·5
Resin, by Daniell's apparatus	2	2·5
Resin and water by the new apparatus ..	2	10·2

And, if to these respective amounts be added 1s. for labour and wear and tear of apparatus, we ascertain approximatively the prime cost of the different sorts of gas delivered into the gasholders, exclusive of the expenses of management, distribution, and interest on capital.

What the issue of a scheme founded on so unstable a foundation will be, it is not difficult to divine. The projector and his friends may of course do as they like with their own, but cannot be permitted to mislead and ruin others, or to unsettle and disturb the good understanding now existing between the producers and consumers of one of the necessaries of life. If we have misstated or misrepresented any of the facts connected with the subject, our columns are open to its advocates to set us and the public right; but we should be wantonly neglecting our duty did we hesitate to expose the impracticability of the project under consideration, and to warn the public against being led away by assertions incapable of being substantiated, and proved to be fallacious by the experience of the last thirty years.

HISTORY OF THE GAS METER.

It might be regretted if the age which produced a machine so ingeniously contrived and so useful to society as the gas meter should pass away without some attempt being made to trace the rise and progress of the invention—what share *each mind* had in its advancement—and how far the principles of previously-existing machinery were applied in its formation. The object of this article will be to inquire into those particulars, and to endeavour to demonstrate the leading principles of action in the various self-acting machines for the measurement of fluids.

The first gas meter was constructed by Samuel Clegg, about the year 1815, and to him has been conceded the honourable appellation of *inventor of the gas meter*. The name *inventor*, however, in this case, as well as most others, is received in too wide a sense; for it may be safely asserted that no man ever *completed* any invention. Savery did but improve on Hero of Alexandria, Newcomen on Savery, and Watt on Newcomen, to produce the steam-engine; and so we shall find, on inquiry into this subject, that Clegg borrowed from the clepsydræ of the ancients, Malam from Archimedes and Clegg; and Crosley and others from Malam, to produce the present gas meter. The title of *inventor* is applied to him who has done *most* towards the progress of a machine; in some cases (like that of Watt) to him who brings it to perfection; in others (like that of Clegg) to the originator; and too frequently to the exclusion of men equally ingenious.

The question as to who was the *true* inventor of the gas meter has been argued in our learned societies, with bitter and angry feelings. Lawyers have pleaded, and judges adjudicated on the subject, and it would be indiscreet to recuscitate animosities long since sunk into oblivion, or to look upon the subject with a party bias. Time has now mellowed asperities. The grave has closed over some of those most deeply interested, and a new generation has sprung into existence, impartial observers of the past, and admirers equally of the great talents of the men at one time placed in antagonism. The period has, therefore, arrived for dispassionate inquiry, while the transactions are yet sufficiently recent to ensure accurate information.

It will not, however, require less circumspection to speak of modern modifications, and to assign to their authors their proper degree of merit, for, when there are so *many* to struggle for so *little*, it may be expected that some will complain of short measure being meted to them. This part must, therefore, be left principally to another pen, and be as lightly touched upon as is consistent with the history of the invention, and the development of the different principles applied to it.

* The oil cost 8s. per cwt., but is reckoned at the price of resin.

To comprehend the action of the gas meter requires some acquaintance with hydrostatics and pneumatics, and, as this knowledge cannot be said to be widely diffused, it will be necessary to enter into explanations, which, though superfluous to men well versed in those sciences, may probably be excused for the benefit of less fortunate readers.

In describing any machine, the clearest method, in my opinion, is to deal first with the leading principles of it, irrespective of details; for, if these are once firmly implanted on the mind, the details can be more readily understood. I will proceed upon this plan, and begin with an instrument which contains the very essence of the gas meter of the present day.

The screw invented by Archimedes for the purpose of raising water first requires our careful study. Its simplest form may be seen in fig. 1; consisting of a cylinder, having an axis at each

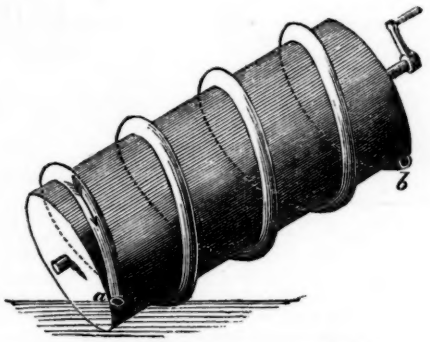


Fig. 1.—Simple Archimedian Screw.

end upon which to rotate, and having a coil of tube passed round it in a spiral form: one end of the cylinder is immersed in the water to be raised, the other end is elevated to a convenient angle.

If this cylinder be turned one half revolution in the direction of the arrow, the open end of the spiral tube, *a*, will have passed through the water, and have received as much water as is due to the cubical contents of the tube immersed at the time the opening of the tube, *a*, rises above the surface. If it be moved one half revolution more in the same direction, the water first received will have passed up the coil, and the place it occupied be filled with air; the quantity of air being equal to the cubical contents of the tube from one water level to the other water level. If another half revolution is made, a second volume of water will be taken up equal to the first, and, when the second revolution is completed, a second volume of air will be received. Each succeeding revolution of the screw, taking up one volume of water and one of air, until (in this case) four revolutions have been made, when the volume of water which first entered the coil will be discharged at the upper part, and immediately afterwards the first volume of air, and so on, at each revolution, one volume of water and one volume of air will be discharged.

It must be evident that so long as the water in the under cistern is kept at the same level, each succeeding volume of water will be equal to the first. This machine, therefore, besides raising water, might be made to register the quantity of water delivered, by means of a series of toothed wheels geared into each other, and showing the number of revolutions made. Indeed, I have an impression on my mind that I have somewhere read that Archimedes asserted his power of measuring water by this means. The principle, however, is so apparent that it could not have long escaped observation.

We have now arrived at the means of measuring water. The supply by this means would be, however, intermittent, and not continuous. The continual supply of water was accomplished by a more complicated screw, seen at fig. 2. This cylinder has four

Fig. 2.—Compound Archimedian Screw.

separate coils of tube, each terminating one quarter of a circle from the other; water by this means being received and discharged at every part of the revolutions by one or more tubes.

To this extent we are indebted to the ancients for the means of measuring fluids, although I know of no instance where it was actually carried out until about the year 1826, when Mr. Crosley constructed a machine upon this principle for measuring water. It was, however, a mere modification of the gas meter, and the principle was well known and proposed by Malam, and must have been also known to Clegg.

If we reflect for an instant upon the screw of Archimedes, it will be apparent that equal quantities of air as well as of water, pass through the coil at each revolution; but this air being taken from the general atmosphere at the bottom of the coil, and returned into it at the top, no measurement of air could be thus effected.

In the invention of new mechanical contrivances it is a rule in nearly all cases that the converse of a proposition holds good; thus, the steam-boat paddle is the converse of the water-wheel—the one may be said to propel water, the other to be propelled by it. The sails of a windmill receive rotatory motion from a direct current of wind; and the new propeller for ships, which is similar in construction, gives direct propulsion by rotatory motion being communicated to it. And so, in like manner, if water can be measured by the intervention of a stratum of air, air can be measured by an intervening stratum of water. The ingenuity of the inventor is displayed in forming a direct reverse of circumstance. We shall see as we proceed with this inquiry how ingeniously this has been effected.

There is still another alteration requisite in this machine to render it either a continuously self-acting measurer of water or air, and that is, to make the fluid the *mover* instead of the *moved*; for, agreeably to the hypothesis already laid down, if the rotation of a screw will give continuous motion to a fluid, a current of fluid will give motion to a screw; and this was effected by Clegg and Malam,—how far by each will be shown in its proper place.

The only other machine which could have been suggestive in the construction of the gas meter was the clepsydræ, or time measurer, of the ancients. This machine was made in many forms, but that which particularly applies to the present case was a wheel with interial chambers; a continuous flow of water from one to the other of which caused rotation, and indicated the hours of the day.

The experimental gasholder as at present used was well known previous to Clegg's time, and was to some extent also serviceable in perfecting the gas meter.

I am now treating this subject on the supposition that the inventors of this machine were acquainted with all that had been done before them; and I do so because it has been irresistibly forced upon me by general experience with regard to other inventions, as well as from the testimony of Malam himself in this case. Inventors are too frequently supposed not to have reached the higher branches of science, because of the absence of high-flown scientific expressions in their conversation, and a general clearness and simplicity of language. Those who are fondest of an opposite style generally deal in words and not ideas, and speak of what they have no conception. The inventions of an ignorant mind, however ingenious, are only repetitions of something previously contrived, while a mind possessed of knowledge, with the same amount of ingenuity, is sure to be conducive to the advancement of science.

I do not mean to infer that the invention of the meter was brought about solely by the train of reasoning which I have followed in attempting to elucidate it. It would be difficult to say, in all cases, how a new combination is formed in the mind. That which I have described will give a conception of one mode, and also tend to give some insight into the principle of the meter.

Upon the introduction of gas lighting it became evident to those concerned in its progress that, if some machine could be contrived by which the new commodity could be sold by measure, its use might be greatly extended. The important position which Mr. Clegg then held as engineer to the only gas company in existence, and his great success in improving gas machinery, induced him to turn his attention to this subject, and no one can doubt that he brought to it a mind fertile in inventive power, and possessing all the science of his time, to which he also added unwearied perseverance.

We have the authority of his son that his first attempt to form a gas meter was by means of two gasholders, the one receiving gas, while the other delivered it, each rising and falling a certain distance, and thereby receiving and delivering given quantities of gas at each oscillation, the seal of the valves for reversing these gasholders from receivers to deliverers of gas being formed of mercury.

This plan he ultimately abandoned, and the result of his experience was embodied in a patent taken out in the year 1816. In this patent two modifications of gas meters are presented, the simplest of which I will describe, not, however, in the language of the patent, for documents of that kind are generally rather verbose.

This (fig. 3, see next page) machine consists of two semi-circular chambers, *a*, *b*, closed on all sides, and attached to an axis, *c*. This axis is hollow, and rotates upon a pivot at one end, and a stuffing-box at the other. The inlet gas pipe is connected with this stuffing-box, and through it keeps up an open communication with the hollow axis, *c*, during its rotation. The axis communicates with

the chambers, *a*, *b*, by means of scroll tubes, *b'*, *a'*, *b*. One of those tubes, *b'*, is shown in the sketch filled with water, and while in that condition will not allow of gas to pass through it; the other, *a'*, is open for the passage of gas.

In the partitions which separate the chambers, *a*, *b*, from each other, there are valves, *m*, *n*, the lids of which are pressed upon by light springs. When these valves are open they allow water to pass from one chamber to the other. There is a hole, *w*, *y*, in each chamber, through which gas may pass to the outer case, in which

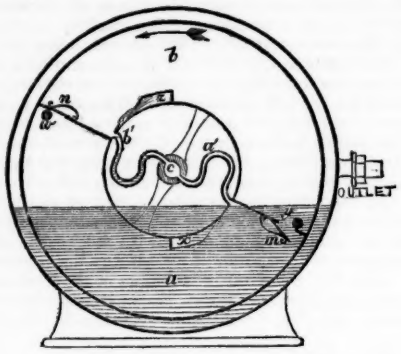


Fig. 3.—Clegg's Meter, 1816.

the wheel is enclosed, and two little buckets, *x*, *z*, the use of which will be explained presently. The machine is filled up to the line shown with water, and is then ready for use, its action being as follows:—

Gas is admitted by the inlet pipe, and, passing through the stuffing-box and hollow axis, enters chamber *a* by the scroll tube, *a'*, and, its pressure acting expansively between the surface of the water and the partition, causes the wheel to rotate in the direction of the arrow, and the water to recede to the left. By this means the gas or air to the left of the water in *a* is expelled into the outer case, and thence to the burner through the hole, *w*. The valve, *m*, here shown open, shuts when the portion of water now in chamber *b* has fallen through it. When the rotation of the wheel has brought the partition in which the valve, *n*, is placed, in contact with the water, the valve, *n*, opens and allows the water to pass into chamber, *b*, thereby expelling the gas in *b* by the hole, *y*.

During this time the little bucket, *x*, which is here shown on the under side of the wheel, will have risen to the upper part, carrying with it a portion of water, in a similar manner to the bucket of a dredging-machine, and, just as the dredging-bucket empties its contents, so will this have emptied its water, which, running down the inside of the chamber, will find its way into the tube, *a'*, and fill it as *b'* is now shown. This will have the effect of stopping the communication between the hollow axis, *c*, and chamber *a*, for, if this were not done before the slit *w* rose above the water, the gas would have passed without moving an intervening stratum of water, and the rotatory motion of the wheel would have consequently ceased. The office of the little buckets, *x* and *z*, will now be apparent, as well as the neatness and ingenuity of the contrivance.

It will be observed that, during this half revolution of the wheel above described, chambers *a* and *b* will have exactly changed positions, and the scroll tube, *b'*, will, by its reversed position, have thrown the water out which sealed the passage of gas through it. The gas will, therefore, pass into chamber *b*, press the water through the valve *n* into *a*, and, indeed, the former process be gone through.

The gas transmitted through this wheel at each revolution will be equal to the cubical contents of the chambers, *a*, *b*. This being, therefore, ascertained, and the motion of the wheel being transmitted to a suitable train of wheels and dials, the quantity passed would be truly registered.

With the knowledge which we now possess of the conditions necessary for the measurement of gas during its transmission to burners, the defects of this machine will at once suggest themselves. The valves, *w y*, exposed to the alternate action of gas and water, could not have long kept in good condition; the stuffing-box, by its friction on the hollow axle, *c*, must have greatly diminished the pressure, while the falling of the water from the buckets, *x z*, and the sudden stopping of the tubes, *a'*, *b'*, must have caused serious oscillation in the lights.

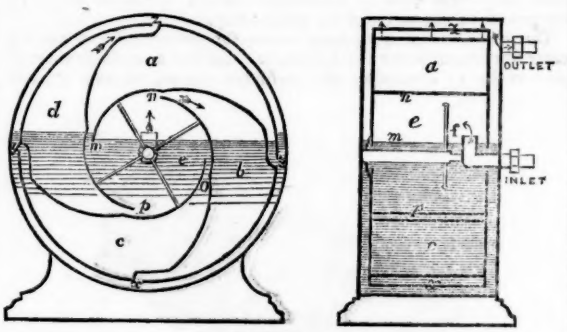
This was the condition of the meter when John Malam turned his attention to the subject. His friends, and those who were intimate with him, say he did so previous to 1819; but the public must deal with such matters in the succession in which they came before them, and can only date their knowledge from the time of publication.

It is but fair, therefore, to consider the invention of the meter up to this point as due to Clegg *only*, and also to infer that Malam was acquainted with what Clegg had done. On the other hand, the opinion that Clegg's meter possessed all the elements of its present state of perfection is unjust towards Malam, who cannot be said to have *only improved* the meter, for he introduced a new principle into its action, and entirely remodelled it, as will be seen when his machine is described and the two are contrasted.

The description and drawings are copied substantially from the paper presented by Malam to the Society of Arts, dated March 10, 1819, and published in the "Transactions" for that year.

Fig. 4 is a section taken across the axis. Fig. 5, a section in a line with it.

Fig. 4. Fig. 5.



J. Malam's Meter, 1819.

The machine consists of a wheel revolving on an axis surrounded by an external case. The wheel is divided into five chambers, one in the centre, and four placed around it. The outer chambers, *a*, *b*, *c*, *d*, communicate with the centre chamber, *e*, by slits, *m*, *n*, *o*, *p*, and with the outer case by slits, *w*, *x*, *y*, *z*. These slits are so placed in respect to each other that those leading to the same chamber (such as *m* and *w* leading to *a*) cannot both be above the water level at the same time. The chamber, therefore, from its opening at *m* to its opening at *w*, spans over an arc of nearly half a circle. The centre chamber has a hole in one of its side plates, through which a bent pipe is inserted; and as one end of the axis bears upon the front of this bent pipe in a socket prepared to receive it, and the other end of the axis bears upon a similar socket attached to the case, the wheel is capable of free rotation without any point of it touching the pipe. The water is filled in sufficiently high to cover the hole through which the bent pipe passes, and in this condition the meter is ready for action.

The gas passes into the inlet, and thence through the bent pipe into the centre chamber, *c*; from thence (having no means of escape into the outer case, the hole in the centre chamber being covered with water) it passes into whichever of the slits, *m*, *n*, *o*, *p*, happen to be above the water line. In the drawing the gas must pass into the chamber *b* by the slit *n*, and, by its expansive action upon the sides of the chambers and the surface of the water, it will cause the wheel to rotate in the direction of the arrow, and expel the water by the slit *x*. When one quarter of a revolution has been effected, the slit *n* will have dipped in the water and the slit *o* risen above it; so that the gas will then enter chamber *c* by *o*, and the water be displaced from it by *y*, and so each slit rising in succession, admits gas into its respective chamber, thereby displacing the water from it. It must also be clear that, while one chamber is thus receiving gas by the displacement of water, the chamber to the left of it is receiving water and displacing gas from it. This would be the effect upon chamber *d* as the wheel is now placed; the water, entering that by *p*, expels the gas by *z* into the outer case, from whence it proceeds to the burners.

The quantity of gas delivered through this wheel each revolution will be equal to the cubical contents of the chambers, less that portion of them in which water is present at the time of the dipping of their respective slits, *m*, *n*, *o*, *p*, in the water. The rotations of the wheel, being conveyed to an index, will give the quantity passed through.

That this meter is based upon the same principle as the screw of Archimedes, and that it is in fact the converse of it, may now be made apparent.

The measurement of water takes place in the screw when less than one-half is immersed in water, by certain volumes of water being separated from each other by columns of air; the air being taken from the general atmosphere, and delivered back to it again when the operation is completed; whilst the water is taken from a reservoir into cavities of certain dimensions, and its quantity ascertained on its passage to the point of delivery.

The measurement of gas takes place in the meter when *more* than one-half is filled with water, by certain volumes of gas being separated from each other by columns of water; the water being received from, and discharged into, the same general receptacle; whilst the gas is taken from a reservoir into cavities of certain dimensions, and its quantity ascertained on its passage to the burners.

This identity in principle in the two machines may not be apparent to the casual obesrver, in consequence of the difference in

appearance between the chambers of the meter and the coils of tube; but the chamber spans over an arc, and is essentially a portion of a screw. The alteration effected in the wheel of the meter by Mr. Crosley, after this time, rendered it in appearance more like the screw, but (as will be shown in the continuation of this article) further removed from it in reality. It would, indeed, be strange if the two machines were not similar, for Malam took the screw for his model.

The most original and ingenious part of this invention is the introduction of the bent pipe, which rises above the level of the water in the central chamber, and delivers gas to it during every part of the rotation, forming what might be called a hydraulic stuffing-box. Whatever merits there may be in the invention generally, this contrivance calls for the special admiration of every mechanical mind, and stamps Malam as an inventor second to none in modern times.

Let us now return to Clegg's original meter. In looking at that it is difficult to say what machines served as models for it. His own revolving gasholder and the clepsydræ might have each been suggestive in its construction; but the cause of its comparative imperfections may be said to lie in its *originality;* for, where a man endeavours to form an entirely new arrangement, it would argue more than human power to suppose that the same perfection could be arrived at, as in the case of one who succeeds him, and adopts not only his ideas in part, but also adopts, as the basis of his invention, a perfect model.

Clegg was the first who suggested and accomplished the measurement of gas by a self-acting machine. He also applied a rotatory wheel, with a stratum of water between the columns of gas. His machine was, however, defective in many points. Malam applied a different and a better principle to it, by which the whole of the valves were made purely hydraulic, and the springs, valves, scrolls, buckets, and stuffing-box were entirely removed.

The invention has been now so fully described that the respective merits of each inventor need hardly be here commented on. Those who have followed the successive ideas developed by them, and entered with delight into the novelty and brilliancy of their conceptions, will award honours to both, which the reader who cursorily peruses this paper might be little inclined to concede. Both men have been neglected by the age in which they lived; and one, "the patriarch of our profession," is still left a living monument of unrewarded genius. X. Z.

(*To be continued.*)

GAS LIGHTING IN PARIS.

We have to thank our Paris correspondent for the following translation of the contract made between the English Gas Company of that City, and each of its consumers, and we cannot but remark and admire the clear and stringent manner in which the rights and obligations of each party are there defined. Our neighbours have wisely avoided the loose and irregular form in which this department of the administration of many, even of the larger gas companies in this country, has been conducted, and to which may be ascribed that great source of loss now sustained by them known as "*stealage,*" in contradistinction to that of *leakage*. Whether it is too late now to attempt the introduction of any improvement, in this respect, merits the serious consideration of gas companies in general, who would find it to their interest to devise some scheme for protecting the honest consumer against the fraudulent one.

The paragraphs printed in italics are inserted in the *contract consumer's* agreement only, and those relating to contract lights are omitted in the *meter consumer's* agreement.

Art. 1. The company, within the district allotted to it by the treaties and contracts approved by royal ordinances, and in the localities where mains are laid, furnishes gas to all persons who may have contracted for its supply, for a period of at least three months, and who may conform to the regulations in force with respect to the fittings and to the stipulations of the present agreement.

Contracts, at per burner, may be made for every day, without exception, or excepting Sundays and feast days; and for lighting from sunset to ten o'clock, eleven o'clock, or till midnight.

Art. 2. The company conducts the gas before the consumer's door, who takes his supply by means of a service pipe branching from the main. The service and all the works connected with it, whether internal or external, are at the expense of the consumer.

The internal fittings shall be constructed by a fitter chosen by the consumer, but in no case can the company be rendered responsible for the soundness of the fittings, the maintenance and repairs of which are at the expense of the consumer.

The service pipe shall be laid and repaired by the company at the cost of the consumer, who can have the charge arbitrated by a surveyor in the usual manner, which charges must be paid to the company before the lighting can take place.*

* Notice is given to the consumer that to obtain a good light the pipes for the distribution of the gas should, under ordinary circumstances, be of the following dimensions:—

For from 1 to 10 lights.	
Service pipe and to the ceiling	1 inch.
Branch for 1 light	½ „
„ 2 to 5 lights	¾ „
„ 6 to 10 „	1 „
For from 11 to 20 lights.	
Service pipe and to the ceiling	1¼ inch.
Branches for 1 to 10 lights	as above.
„ 11 to 20 „	1¼ inch.
For from 21 to 30 lights.	
Service pipe and to the ceiling	1½ inch.
Branches for 1 to 20 lights	as above.
„ 21 to 30 „	1½ inch.
For from 31 to 50 lights.	
Service pipe and to the ceiling	2 inches.
Branches for 1 to 30 lights	as above.
„ 31 to 50 „	2 inches.

The above dimensions should be proportionally augmented for a greater number than fifty lights; they should also be modified, according to circumstances, when the places to be lighted are situated more than twenty yards from the main, or when the lights are placed in cellars or other places below the level of the street.

When any repairs of drains, water pipes, or paving take place, the consumer before whose door they are executed, will do well to see that the service pipe by which the gas is conveyed to him is not damaged, or in the contrary case to give notice to the company.

The exterior cock, destined to put the gas in communication with the interior fittings, shall also be fixed by the company at the expense of the consumer.

This cock may, by consent of the consumer, be furnished by the company, who, in this case, will undertake its repair and that of the box containing it, in consideration of a charge of fivepence per month.

If the consumer prefers to provide this cock himself, the box containing it shall be fixed in such a manner as to be covered by the door which the company shall provide.

The top of the cock must always be placed in front of the door by which the key of the consumer is introduced.

The consumer shall keep in repair the cock which he may have provided, and the company shall have the right of fixing, for their own use, another cock in advance of that of the consumer.

With respect to the cocks already fixed, the company is obliged to keep them in repair at a charge of fivepence per month, unless the consumer prefers to take their repair upon himself, in which case the company shall have the right of placing another cock upon the service in advance of that of the consumer.

In all cases the servants of the company shall have the sole right of opening and closing the external cock; they alone shall have in their possession the key of the door enclosing the cocks, but shall be bound to open the consumer's cock every time it may be necessary for its repair.

The company shall not be responsible for any interruption of the lighting, nor for any accident arising from the bad construction or repair of the cock furnished and repaired by the consumer.

At the expiration of the contract for lighting, the external service pipe may be cut off at the expense of the consumer if the contract is not renewed within five days.

The gas shall be supplied by meter.

Conformably to the right which is assigned to it by the beforementioned treaty, to select a meter amongst those approved of by the authorities, without the choice being made of a system the manufacture of which is not open to the public, the company has chosen the Crosley water-meter, of which the manufacture and improvements introduced in England are open to the public.

The consumer is consequently bound to use a meter of this construction, made by any manufacturer he may select.

The meter shall be proportionate in size to the maximum consumption.

It shall be submitted to such proof as the authorities shall think requisite to ascertain its exact and regular working, without prejudice to such as the consumer or company may judge necesary.

The maintenance and repair of the meter are at the expense of the consumer.

The meter shall be fixed and maintained by screws or sealed fastenings upon a perfectly level platform. The screws of the inlet and outlet pipes shall be sealed with the seal of the company. Any rupture of these seals by the consumer or his agents may be made the ground of an action for damages, and be legally sued for and penalties recovered.

The consumer is formally interdicted from changing or deteriorating the meter and its accessories.

The consumer is bound to allow the agents of the company free access to the place where the meter is fixed. Any refusal may be made the ground of an action at law.

The consumer cannot during his contract displace any of the lights or pipes, or make any change in his fittings, without giving notice to the company.

Any surreptitious lights or burners whatever, whether existing upon the interior or exterior pipes, beyond those included in the contract, shall form the ground for an action on the part of the company for damages, without prejudice to a prosecution which the company reserves to itself the right of instituting in cases where the burner may have been fixed with a fraudulent intent.

The company shall have the right of inspecting all burners existing at any consumer's.

Art. 4. The consumer shall have the right dispose of the gas which has passed the meter as he shall see fit, either in the interior

or exterior of his house; but, in case the number of lights he has declared for be exceeded, the company shall not be liable for any damages in consequence of the weakness of the light.

Any act having for its object the obtaining of gas without the consent of the company, or beyond the quantity passing the meter, will be made the subject of a prosecution.

Art. 5. The consumer can only require to be lighted during those hours when the mains are charged with gas. Any exception to this rule must be made a matter of mutual arrangement between the company and the consumer.

Art. 6. On and after the 1st of January, 1847, the price of gas supplied by meter shall be fixed conformably to the following scale:—

	s.	d.	
In 1847	11	0	per 1000 feet.
1848	10	9¼	do.
1849	10	6½	do.
1850	10	3¾	do.
1851	10	1	do.
1852	9	10¼	do.
1853	9	7½	do.
1854	9	4¾	do.
1855	9	2	do.
1856 and following years	8	11¼	do.

On and after the 1st of January, 1847, the price of gas by the hour for cylindrical burners having an interior and exterior current of air (called Argands) shall be fixed conformably to the following scale:—

Per light per hour from sunset.

	To 10 o'clock. Price per hour.	*To 11 o'clock and midnight.* Price per hour.
1847	0·621d.	0·565d.
1848	0.6154	0·561
1849	0·6098	0·557
1850	0·6042	0·553
1851	0·5986	0·549
1852	0·5930	0·545
1853	0·5874	0·541
1854	0·5818	0·537
1855	0·5762	0·533
1856	0·570	0.530

and following years.

The sums to be paid each month for every day in the year without exception shall be calculated according to the above-mentioned prices for the number of hours indicated in the following table:—

Extinguishing

Month.	*At* 10 o'clock. *Hour.*	*Min.*	*At* 11 o'clock. *Hour.*	*Min.*	*At midnight. Hour.*	*Min.*
January	175	20	206	20	237	20
February	138	20	166	20	194	20
March	127	20	158	20	189	20
April	97	20	127	20	157	20
May	74	20	105	20	136	20
June	54	20	84	20	114	20
July	61	20	92	20	123	20
August	87	20	118	20	149	20
September	119	20	149	20	179	20
October	158	20	189	20	220	20
November	177	20	207	20	237	20
December	189	20	220	20	257	20
Being for the year	1460	*hours.*	1825	*hours.*	2190	*hours.*

The sums to be paid by consumers who do not burn on Sundays and feast days shall be calculated according to the above table, deducting the hours due to any Sunday or feast day falling in the month.

The burners to which the above prices apply, are those pierced with 20 holes, each hole being of the diameter of 0·$\frac{1}{76}$ inch; the height of the flame shall be 3$\frac{1}{8}$ inches, and that of the chimney glass shall not exceed 8 inches.

The chimney glass should be fitted to the holder, so that the flame can only receive the external air through the apertures pierced in the holder; the burner thus described being similar to the model one deposited at the Prefecture of Police, together with its holder, chimney glass, and accessories.

The consumption of this burner should be on an average 4¼ feet per hour.

The price of all other lights besides those described above, or for lighting at any other hours besides those specified in the above table, shall be mutually agreed between the company and the consumer.

This shall also be the case for the 20-hole argand burner placed outside the houses, that is to say, in the public streets, courts, gardens, and other localities not covered in.

Lights, the extinction of which is to take place at different hours, may be supplied by the same service, but each class shall have a special cock upon the pipe supplying it, which shall be fixed outside, and be opened and closed by the servants of the company.

The consumer should only open the cocks under his control, at the moment when the lighting takes place, and should close them at the hour fixed upon for the extinction.

The consumer shall not make use of the gas at other hours than those for which he agrees, even should the gas be at his disposal.

Art. 7. The price of the lighting is payable monthly in advance at the residence of the consumer; he shall deposit with the company the sum of 6s. 6d. per light, as representing approximatively the value of the gas consumed per light per month.

This deposit shall be repaid by the company to the consumer when he ceases to burn gas, deducting any arrears due.

The payments shall be made on presentation of the account, when the quantity consumed has been ascertained; in default of payment within five days afterwards, the company may refuse to continue the supply of gas, reserving to themselves the right to enforce the execution of the present contract.

The consumer renounces the right to refuse payment on the ground of any error in the quantity of gas stated to be consumed; the account shall always be paid on presentation, and the company will credit the consumer in the future payments for any error which may have been committed to his prejudice, unless he prefer to receive in cash the amount of his claims which may be acknowledged to be founded.

Art. 8. In case of any unavoidable accident compelling the company momentarily to suspend the lighting, the company shall not be liable to any indemnity, but simply to repay the value of the gas paid in advance which shall not have been supplied.

SUPPLEMENTARY NOTICE

Relative to gas-lighting, and the precautions to be taken in its use.

To prevent any inconvenience in the use of gas, it is requisite that the burners allow none to escape without being burnt.

This result is obtained by maintaining the flame at a moderate height (3$\frac{1}{8}$ inch at the most), and confining it within a chimney glass of 8 inches high.

The rooms lighted should be carefully ventilated, even during the cessation of lighting, by openings in the ceiling, through which the gas, in case of leaks or non-combustion may escape.

Without this precaution the unburnt gas may accumulate in an apartment, and occasion suffocations, explosions, and fires.

The plugs of the cocks should be greased from time to time, so as to prevent oxidation and facilitate their working.

In *lighting*, it is essential to open, in the first instance, the main cock, and then to apply a light successively to each burner at the moment of opening its cock, so as to prevent the escape of any unconsumed gas.

In *extinguishing*, it is better to close, in the first instance, the main cock, and afterwards those of each of the burners. In all places where the interior and exterior main cocks are not connected, the interior one should be closed at the moment of extension, even after the closing of the exterior cock, so as to prevent the escape of gas in the apartment when the exterior cock is opened next day.

Whenever any smell of gas gives rise to the belief that a leak exists, the doors and windows should be opened, so as to cause a current of air, and the exterior main cock should be closed.

Notice should be simultaneously given to the company supplying the gas and to the gas fitter, so that the leak may be immediately repaired.

The consumer should abstain from searching for any leak with a light.

In case, whether by imprudence or by accident, the escape shall have been ignited, the best means of extinguishing it is to cover it with a linen cloth steeped in water.

INAUGURAL LECTURE,

READ BY MR. CLEGG, JUN., BEFORE THE COLLEGE OF CIVIL ENGINEERS, PUTNEY, ON WEDNESDAY, SEPT. 26.

Civil engineering and architecture, the subjects upon which I am called to lecture, are both essentially practical sciences, and are in some measure so connected as to be synonymous; both the engineer and the architect must be well versed in the strength of the various materials with which they have to deal, and be so acquainted with their properties as to be enabled to make a choice of them for any peculiar circumstances attending their work.

Both must be mathematicians, draughtsmen, carpenters, masons, and be acquainted with the details of all, or nearly all, the mechanical trades; at least they must be learned judges of them, if not skilful operators.

They must both be men of business, and should not be ignorant of law. Both architecture and engineering, therefore, in their most comprehensive meanings, are studies of many and singularly opposite qualities, and are allowed by all whose opinions are worth regarding to be sciences of the highest importance to the well-being of society; thus far the two professions go side by side. But architecture, as well as being a science, is also essentially a fine art, and here the two professions separate. The path of the architect will, after he has gained his practical knowledge of construction and building, be parallel with that of the painter and the poet in the regions of cultivated taste. The path of the civil engineer is widely different; and, if his labours be less in the captivating regions of beauty than the architect's, they are, perhaps, more among the grand—certainly more among the stern development of massive strength, to resist shocks, inundations, and storms, which,

from the simplicity of the requisite forms, and their associations, constitute grandeur. I come amongst you fully sensible of the responsibilities of my office, and with an equally full determination to perform its duties to the utmost of my power; and I shall expect you to go with me cheerfully to the tasks which lie before us, and assist me with your diligence. Nothing is more necessary to the due understanding and proper study of engineering and architecture, and to the formation of a proficient in either, than habits of application and industry. Without them even the lowest departments of the professions are not to be mastered. It is not a rapid growth that produces a sound and skilful practitioner, any more than precocity is an emblem of a great statesman. It is not by occasional fits of application, by short starts of preparation, by numerous little works, performed in a little time, and with less study, sometimes discontinued, and again renewed, that eminence is to be obtained in either of these arts; on the contrary, it is only by regular application—by a constant study of good examples—by able instruction, by deep and intense study of the elementary principles, with an uninterrupted practice, solely directed to the object, grown up almost into a habit, and ready to be called into use at the shortest notice—it is only by sacrificing every comfort that aims at prevention—by having resolution to suffer nothing to impede your progress, and by avoiding the dead sea of idleness and pleasure, that you can be enabled to shine either as an architect or as an engineer. Michel Angelo, full of the great and sublime ideas of his art, lived very much alone, and never suffered a day to pass without handling his chisel or his pencil. When some person reproached him for leading so melancholy and solitary a life, he said, "Art is a jealous thing, and requires the whole and entire man." He was also both frugal and temperate, and so persevering in his labour that he used occasionally at night to throw himself upon his bed without disencumbering himself of the clothes he had worked in. Inigo Jones, by his indefatigable zeal, raised himself from the position of a working mechanic to that of the first architect of the day. He was bound apprentice to a joiner; but the Earl of Arundel, seeing his talent and ingenuity, sent him to Rome to study landscape painting. When at Rome, finding that he possessed more talent for designing palaces than adorning cabinets, he turned his study to architecture. By denying himself the common necessaries of life—by rising early and retiring late, sometimes not going to his bed at all, he conquered all the difficulties in his path; and after remaining some time in Italy, shackled by poverty, Christian the Fourth of Sweden invited him to Denmark, and appointed him his architect. He afterwards returned to England, and was made surveyor-general of the King's works to James I., but refused to accept any salary until the heavy debts contracted under his predecessor had been liquidated. Upon the accession of Charles he was continued in his office, when his salary as surveyor was 8s. 4d. per day, with an allowance of £46 per year for house rent. Sir Christopher Wren is an example of an architect excelling in mathematics, and producing works bearing the evident impress of their author's learning. From the number and diversity of his occupations may be gathered the fact of his close study and application; and although, unlike Inigo Jones, he had not poverty to fight against, infinite credit is due to him. He was one of the original members of the club which was formed at Oxford in 1648 for philosophical discussion and experiments, and which eventually gave rise to the Royal Society. In 1657 he was chosen professor of astronomy at Gresham College, and on the restoration was appointed to the Savilian professorship of astronomy at Oxford. It was very soon after this that he was first called upon to exercise his genius in architecture (a study, however, which had previously engaged a good deal of his attention), by being appointed assistant to the surveyor-general. This led to Wren's employment on the work on which his popular fame principally rests—the rebuilding of the Cathedral of St. Paul's after the great fire. The erection of this noble edifice occupied him for 35 years, but did not prevent him during the same period from designing and superintending the completion of many other buildings, nor even interrupted his pursuit of the most abstract branches of science. Wren was created a doctor of law and logic by the University of Oxford in 1661, and was knighted in 1674. In 1680 he was elected to the presidency of the Royal Society, and in 1685 he entered Parliament as the representative of the borough of Plympton. While superintending the erection of St. Paul's all the salary Wren received was £200. He was also used by the commissioners in other respects with extreme illiberality and meanness, and was obliged to yield so far to their ignorant clamour as to alter the design of his building and to decrease the size of his dome, which he had intended should spring from the outside large gallery which surrounds it. If he had had the moral courage of Michel Angelo, we should have had yet a nobler monument of his fame. Michel Angelo, like Wren, had obstacles thrown in his way, and we are told the following anecdote:—Under the papacy of Julius III. the faction of Michel Angelo's rival, San Gallo, gave him some trouble respecting the building of St. Peter's, and went so far as to prevail upon that Pope to appoint a committee to examine the fabric. Julius told him that a particular part of the church was dark. "Who told you that, holy father?" replied the artist. "I did," said Cardinal Marcello. "Your eminence should consider, then," said Michel Angelo, "that, besides the window there is at present, I intend to have one in the ceiling of the church." "You did not tell me so," replied the cardinal. "No, indeed, I did not, sir; I am not obliged to do it, and I would never consent to be obliged to tell your eminence, or any other person whomsoever, anything concerning it. Your business is to take care that money is plenty in Rome, that there are no thieves there,—to let me alone, and to permit me to proceed with my plan as I please." Wren's ungrateful employers, in 1718, dismissed him from his place of surveyor of public works: he was at this time in the 86th year of his age. This great and good man died at Hampton Court on the 25th of February, 1723, in the 91st year of his age. His remains were accompanied by a splendid attendance to their appropriate resting-place under the noble edifice which his genius had reared, and over the grave was fixed a tablet, with the following inscription:—"Beneath is laid the builder of this church and city, Christopher Wren, who lived about 90 years, not for himself but for the public good. Reader, if thou seekest for his monument, look around."

Great architects, if uniting with their works any other pursuit or study, have generally fixed upon some branch of science or art connected with architecture: thus, Michel Angelo was a sculptor; Inigo Jones was a painter, and then an astronomer. But Sir John Vanbrugh was a dramatist as well as an architect; he wrote "The Provoked Wife," "Esop," and other comedies, and built Blenheim and Castle Howard.

Were I to give the character of each and all the eminent architects of this or any other country, they would serve to show how great was the amount of their labour, and with what cheerfulness and perseverance they pursued their tasks at the commencement of their career, and with what determined energy they maintained their name and fame after they had risen to excellence: nor will the characters of civil engineers lose by comparison with the already-named artists.

When the state of civilization and trade in England required more convenient and cheaper modes of transit for its goods than the common roads and waggons of the day afforded, a system of inland navigation was proposed, and Mr. Smeaton was employed in making rivers available for this purpose; afterwards, more direct routes became desirable, and canals were projected, in imitation of those made before by the Dutch and French. The Duke of Bridgewater was the great patron of these schemes, and brought forward James Brindley, who constructed for him the canal, called the Bridgewater Canal, between Liverpool and Manchester. This immense work, the idea of which was ridiculed by most of the scientific men of the period as impracticable, Brindley undertook, and completed so as to form a junction with the Mersey. This success caused him to be employed, in 1766, to unite the Trent and Mersey, upon which he commenced the Grand Trunk Navigation Canal. From this main branch Mr. Brindley cut another canal near Haywood, in Staffordshire, uniting it with the Severn in the vicinity of Bewdley, and finished it in 1772. From this period scarcely any work of the kind in the kingdom was entered upon without his superintendence or advice. Among other designs, he prepared one for draining the fens of Lincolnshire and the Isle of Ely, and another for clearing the Liverpool Docks of mud, which was especially successful. The variety of his inventions, and the fertility of his resources, were only equalled by the simplicity of the means by which he carried his expedients into effect. He seldom used any model or drawing, but, when any material difficulty presented itself, he used to seclude himself for days, or until an idea presented itself to him for overcoming it; and so partial was he to inland navigation that, upon the question being put to him by the opposition to one of his schemes, "For what purpose he imagined rivers to have been created?" he at once replied, "Undoubtedly to feed navigable canals." The intensity of his application to business brought on a fever, of which he died in 1772, in the fifty-sixth year of his age.

John Smeaton, another engineer, who did much to advance his profession in this country, may almost be said to have been born an engineer, his genius appeared at so early an age. His playthings were not those of children, but the tools which men employ. Before he was six years of age, he was discovered on the top of his father's barn, fixing up what he called a windmill of his own construction; and at another time, while he was about the same age, he attended some men fixing a pump, and, observing that they cut off a piece of the bored pipe, he procured it, and actually made a pump with it which raised water. When he was under fifteen years of age, he made an engine for turning, and worked several things in ivory and wood, which he presented to his friends. A part of every day was occupied in forming some ingenious piece of mechanism. In 1751 he began a course of experiments to try a machine of his own invention, to measure a ship's way at sea, and made two voyages to try the effect of it, and also to make experiments upon a compass of his construction. In 1753 he was elected a fellow of the Royal Society, and the number of papers he published in their "Transactions" will show how highly he deserved the honour of being enrolled a member of that useful and important body: in 1759 he received the gold medal.

In 1775 the Eddystone Lighthouse was burned down, and, Mr. Smeaton being recommended to the proprietors of that building as an engineer in every way calculated to rebuild it, he undertook the work, which was completed in 1759. To this work I shall

allude more particularly when instructing you in the building of lighthouses, as the practice of building then adopted has been continued to this day. But the part of Mr. Smeaton's life I would more particularly draw your attention to is this. During many years he was a frequent attendant upon Parliament, his opinion upon various works begun or projected being continually called for, and in these cases his strength of judgment and perspicuity of expression had full scope.

It was his constant custom when applied to, to plan or to support any measure, to make himself fully master of the subject, to understand its merits and probable defects, before he would engage in it. By this caution, added to the clearness of his expression and the integrity of his heart, he seldom failed to obtain for the bill which he supported the sanction of Parliament. No one was ever heard with more attention, nor had any one ever more confidence placed in his testimony. In the courts of law he had several compliments paid him from the bench by Lord Mansfield and other judges for the new light he always threw on difficult subjects. Mr. Smeaton died in 1792, in the 68th year of his age.

John Rennie, to whom England is indebted for some of her noblest engineering works, was born on the 7th of June, 1761, at Phantassie, in the parish of Prestonkirk, in the county of East Lothian. His father, a highly-respectable farmer, died in 1766, leaving a widow and nine children, of whom John was the youngest. The first rudiments of his education were acquired at the village school. It so happened that he had to cross a brook on the way, which, when flooded, obliged him to make use of a boat kept in the workshop of Mr. Andrew Meikle, an ingenious mechanic, well known in Scotland as the inventor of the thrashing-machine. In passing so frequently through this workshop, young Rennie's attention was directed to the various operations in which the men were engaged; and they, noticing the interest he took in their labours, were in the habit of lending him tools and showing him their use. In the evenings he amused himself with endeavouring to imitate the models he had seen at the shop; and it is related that, at little more than ten years of age, he had completed the models of a windmill, a pile-engine, and a steam-engine. Rennie continued at the Preston school till twelve years of age, when, having had a quarrel with his master, he entreated to be allowed to leave, and, at his own request, was placed for two years with Mr. Meikle. At the end of that time, feeling that a constant application to manual labour was likely to retard his mental improvement, he determined to become a pupil of Mr. Gibson, an able mathematical teacher at Dunbar. Here he soon attained great proficiency, and in less than two years returned to Mr. Meikle with a mind well stored with mathematical and physical science. His first essay in practical mechanics was the repairing of a corn-mill in his native village; and before he was eighteen years of age he had erected several others. During this time he occasionally visited Edinburgh to pursue his studies in physical science, under Professors Robinson and Black. The former of these gentlemen may, perhaps, have laid the foundation of his future fortune, by introducing him to Messrs. Boulton and Watt, of Soho. Deeming the capital the proper theatre to try the strength of his own powers, Rennie settled in London, after having been a few months only with Boulton and Watt, who had confided to him the superintendence of the mill-work of the Albion Mills, then erecting. Mr. Rennie was thus led to study hydraulic engineering, in which he became so celebrated as, after the death of Smeaton, to have no rival. Amongst the most celebrated works of this great engineer must be mentioned—besides numerous mills, bridges, canals—London, Waterloo, and Southwark bridges; the Lancaster Canal; with the aqueduct over the Lune; the breakwater in Plymouth Sound; and the improvements in the dockyards at Portsmouth, Plymouth, Chatham, and Sheerness. The industry of Mr. Rennie was so great that he never suffered amusement of any kind to interfere with his business, which frequently occupied him twelve, and sometimes fifteen, hours in the day. He was clear in his mode of communicating information to others, and pleased when he found that information was desired. He was never actuated by professional jealousy, or selfish feelings, but was always kind and condescending to the more humble members of his profession. Mr. Rennie died on the 16th of October, 1821, in the sixtieth year of his age, and was buried in St. Paul's, where his remains repose near to those of Sir Christopher Wren.

Thomas Telford was born in 1757, and commenced his life as a shepherd boy in Eskdale; but his early and eager love of knowledge led him to seek abroad an occupation more suited to his inclinations. He first repaired to Edinburgh, where he studied architecture with unremitting application, although he must have earned his daily bread by the labour of his hands. In 1782 he was emboldened to try his fortune in London, and was (as he states in his life, written by himself) fortunate enough to be employed at the quadrangle at Somerset-place, where he acquired much practical information, both in the useful and ornamental branches of architecture. After a residence of two years in London, he was engaged in superintending the building of a house in the Portsmouth Dockyard. "During the three years," he remarks, "that I was employed in building the commissioner's house, and of a new chapel in the dockyard, I had an opportunity of observing the various operations necessary in the foundation and construction of graving-docks, wharf-walls, and similar works, which afterwards became my chief employment." When he left Portsmouth, he was appointed surveyor to the county of Salop; and to this, and the connections formed at this time, he was indebted for a very favourable opening of his career as a civil engineer. His chief attention was devoted to building and repairing bridges; but he also built several churches and other architectural edifices.

Telford's progress in his professional career, though not rapid, was steady and certain, and every new opportunity of exerting his talents contributed to extend a reputation which at length became unrivalled—not to his talents alone though, be it said, but by downright hard work united with them. To enumerate all his works would take a long time, but his principal ones are the Holyhead-road (upon which he himself sets higher value than any other), and the Menai-bridge, unquestionably the most imperishable monument of Telford's fame.

The defects of his early education he had endeavoured to remedy by his own unaided exertions in his maturer years. He taught himself Latin, French, German, and mathematics, in which he was a proficient, but relied more for the dimensions of his works upon practical experiment than upon calculation; but his reason for the preference may have been, and most likely was, his distrust of the data furnished him by mathematical experimenters in those days; but, now that we have had Barlow and Hodgkinson, calculations from the results of their labours may be safely relied on.

Telford was the first president of the Institution of Civil Engineers, and died, still holding that office, in 1834, aged seventy-seven years.

From these few instances in the lives of men devoted to science and to art, the student will learn the necessity of study, exertion, and self-dependence. An architect or an engineer, taking up his work as a task or merely with the business-like view of earning a livelihood, will never excel. In the days when men of science were comparatively scarce, great perseverance was necessary to get into notice and rise to fame; but double exertions are now necessary: an aspirant to professional honour will find himself jostled and hard set by competitors at every step of his progress, and this must raise up within him a determined spirit of emulation—a spirit not to be daunted or cast down by failures, but one that will become more buoyant by pressure, one that, with steady stride and upright head, will still walk up the steep and difficult path which leads to fortune. (*To be continued.*)

ON THE IMPORTANCE TO GAS COMPANIES OF RENTING OR OTHERWISE SUPPLYING GAS FITTINGS.

When the amount of capital that is invested in the various branches of gas lighting is taken into consideration, it must be a matter of considerable interest to the gas world at large to introduce, or carry into effect, any system that will make the use of gas more general, and, consequently, render gas property more productive; and it is with this intention that the present paper is written.

It is a well-known fact that the profits of a gas company depend mainly upon the quantity of gas they manufacture and supply—the question of quantity being of far more importance than that of price—and the reasons for this must be so well understood by all existing gas companies, as to render it unnecessary that they should be stated in this paper.

Quantity being admitted to be the point to be sought for and acquired, it becomes a matter for our consideration how to obtain this, and at the same time so as to have as large a supply as possible in the shortest distance (for quantity alone, irrespective of distance, will not bear out the foregoing assertion); and this brings the subject of the supply of gas fittings by companies at once to our view, as being a mode by which the principal obstacle to the use of gas by the public may be removed, by enabling them to obtain their gas fittings at a cheap rate, or on a rental; and it is hoped that the writer will be able to prove satisfactorily that this is not only to be accomplished, but in a way highly beneficial both to gas companies and the public, but especially so to the former.

Upon the first introduction of gas lighting, the supply and fixing of the fittings necessary for its distribution and consumption was a matter not only imperfectly understood, but considered of so little importance as to be left in the hands of persons entirely unacquainted with their requirements, and certainly not in any way qualified to carry them out in a perfect or satisfactory manner; and even now very little attention is given by many gas companies to this most important branch of their business, and which they would, had they consulted the interests of their consumers and themselves, have always retained in their hands.

Had the companies attended to the fixing of gas fittings, they would have prevented the prejudices existing against the use of gas, especially for private houses, and which have been caused from the accidents that have occurred through defective fittings and careless workmen; and also enabled persons to have obtained their fittings at a reasonable rate, the great cost of which has hitherto prevented them introducing gas into their houses.

By the attention that would be given to this branch of the distribution, the working pressures could be materially reduced; as at present much is absorbed in *forcing* the gas into those pipes and fittings that have been fixed without care or knowledge of the

requirements of the house, thus causing serious loss to the company, and inconvenience to those customers whose fittings are of sufficient capacity and well arranged.

The company, undertaking this work under proper management, will at once relieve the fears of the nervous, as it would be their interest to see that the work was executed in a proper manner, and, by bringing their customers more often in connection with the officers of the company, bring about a better feeling, and, with the reduction in price that they would be enabled to make, render opposition almost impossible.

It must be remembered that this increased consumption will not add materially to the costs of the company, as the only additional expenditure will be for retorts, coals, lime, and labour. The same mains and works will, in nearly every case, be sufficient to supply more than they at present do; and this will be especially the case during the summer season, for, as this additional consumption is to be gained by the use of gas for domestic purposes, it will create a demand at the time when the plant and works are comparatively idle; and it must be manifest that all those who now use gas for their business purposes, would also avail themselves of its advantage for their private lighting, as no other artificial light, from whatever source derived, can be supplied so conveniently and at so economical a rate as that produced from gas.

To fit up a gentleman's house in good style with the requisite fittings for 20 lights, including chandeliers, meter, service, &c. (but not the labour), will be about £30; and upon this sum a rental of 10 per cent. per annum should be charged for their hire or loan; this would produce an annual rent of £3. The gas that would be consumed in such a house would be, at 6s. per 1000 cubic feet, about £10 per annum, making, with the rent of the fittings, £13 per annum. The profit to be derived by the gas company from this rental of £10 will be near £6, to which will have to be added the foregoing £3, making a profit rent of £9 per annum. A house with ten lights can be fitted up complete for £15, and should produce a gas rental of about £6, the profit upon which, with the rental, would be £5 per annum. A house with five lights would cost about £6, and produce, with the rental of the fittings, an annual profit of say £2. 10s. Supposing this to be done to the extent of 400 houses, the result will be as follows:—

100	Houses	at £30	expenditure,	£3000
100	do.	at £15	do.	1500
200	do.	at £6	do.	1200
			Total capital	£5700.
100	Houses	at £9	. . .	£900
100	do.	at £5	. . .	500
200	do.	at £2. 10s.	. . .	500
			Annual profit of	£1900

and which, on the above expended capital of £5700, will afford a profit of 33⅓ per cent.

If larger or smaller houses be included in a similar statement to the foregoing, and the average taken, the result will be nearly the same.

To illustrate the advantages to be derived by gas companies, and to induce them to adopt the system recommended, the following statement is submitted:—

The supply of gas fittings, &c., at an annual rental, as also by sale at cost price, was introduced into Devonport in June, 1847, and the increased demand for gas has quite borne out all that was stated in its favour at that time.

From June 1, 1846, to May 31, 1847, the quantity of gas supplied by meter was 8,939,035 cubic feet, producing, at 6s. per 1000, £2681. 14s. 3d., and giving 2350 feet, or 14s. 1d. per house; and 263 feet, or 1s. 7d. per head, or 10,516 feet, equal to 60s. per house lighted.

From June 1, 1847, to May 31, 1848, it was 11,306,360 cubic feet, or £3571. 18s. 2d.; 3142 feet, or 18s. 10d. per house; 350 feet, or 2s. 2d. per head; 11,468 feet, or 69s. per house lighted.

From June 1, 1848, to May 31, 1849, it was 15,366,650 cubic feet, or £4609. 19s. 10½d.; 4055 feet, or 24s. 4d. per house; 452 feet, or 2s. 8½d. per head; and 11,650 feet, or 69s. 10½d. per house lighted.

There are in Devonport 3789 houses, offices, and tenements, and 34,000 inhabitants. In the year ending 1847 the number of houses lighted with gas was 850; for the year ending 1848, it was 951 (being the first year of the fitting rental system); and for the year ending 1849, the number was 1319.

The increase in 1848 over that of 1847 was equal to 33⅓ per cent.; and of 1849, of 66⅔ per cent.

On the 29th of September, 1848, the United General Gas Company handed over to the Devonport Gas Company their business, which amounted to 4,130,000 cubic feet per annum (ascertained from the consumers' meters); and to this the increase in the year ending May 31, 1849, is partly owing.

It will be found that the companies in general expend about one-third of the amount of their capital in the mains and services, and, if they would but add an additional sum in the purchase of gas fittings, they would not only secure a high rate of interest for their additional outlay, but tend materially to make more productive the capital previously expended.

Post and columns, lamps, burners, service pipes, &c., are generally supplied to unproductive customers, and this renders it the more inconsistent not to confer a similar boon on those whose support enables the company to supply gas to the public lamps at a loss, and still keep them in a position to pay dividends.

The City and Suburban Gas Company of Glasgow supplies their customers with service pipes and meters free of charges, and, no doubt, find the benefit of such a measure in increased consumption; and there can be no question but that, if all companies would follow so good an example, they would be alike gainers, and the only surprise is that this and other preventions to the use of gas have not been abandoned.

Although recommending the adoption of the system of lending gas fittings on a rental, or of selling them at cost price, the writer is quite prepared to recommend the furnishing gratuitously to any person who will have gas all the requisite pipes and fittings (excepting chandeliers and expensive brass work); and if persons interested in gas property will calculate the probable cost of the adoption of such a system in their own locality, and ascertain the gas rental to be obtained therefrom, they will convince themselves of the very great profit to be derived from such a system; indeed, very few houses would remain in their present state of comparative darkness: various modifications could be made to suit the circumstances of the company, but it is evident that some impetus is required at the present time to assist in promoting the extension of the use of gas, and the adoption of either of the systems recommended must be attended with success. In concluding this paper, it will be necessary to enumerate the systems attempted to be introduced, namely, lending gas fittings on hire at an annual rent charge; selling gas fittings at first cost; or supplying gas fittings and meters to the public (excepting expensive brass work) without charge.

The writer is convinced that, whatever may be the present objections to either of these systems, they must be adopted at no very distant period.

The business of a brewer is somewhat analogous to that of a gas company, the casks doing for the former what the pipes and fittings do for the latter. In all cases the brewer supplies his customers with casks free of charge, and would find a difference in his consumption did he compel their purchase, but no other manufacturers have placed so many obstacles in the way of the use of their commodity as gas manufacturers. First, you must pay for your service pipes,* then for the meter, and finally the gas fittings. Supply these things free of charge, and gas will be what it is so well fitted for,—the universal light. THOS. A. HEDLEY.

* The charge for laying service pipes and for meters is not so general as it used to be, but it still exists.

A STATISTICAL ACCOUNT showing the Number of Houses, the Number of Inhabitants, the Amount of Gas consumed by Meter, the Rate per House, the Rate per Head, &c., in Devonport, to prove the advantages to be derived from Gas Companies undertaking the supply of Gas Fittings at an annual rental, or on sale at first cost. The Gas is calculated at six shillings per thousand cubic feet:—

Date.	Amount of Gas consumed by Meter.	Rental, at 6s. per 1000 Feet.	No. of Inhabitants.	Rate per Head, in Gas.	Rate per Head, in Money.	Total No. of Houses.	Rate per House, in Gas.	Rate per House, in Money.	No. of Houses Lighted.	Rate per House Lighted, in Gas.	Rate per House Lighted, in Money.	Per Centage of Increase over 1847.
	Cubic Feet.	£ s. d.		Cubic Ft.	s. d.		Cubic Ft.	s. d.		Cubic Ft.	s. d.	
May 31, 1847 .	8,939,035	2681 14 3	34,000	263	1 7	3789	2350	14 1	850	10,516	60 0	—
May 31, 1848 .	11,906,360	3571 18 2	34,000	350	2 2	3789	3142	18 10	951	11,468	69 0	33⅓
May 31, 1849 .	15,366,650	4609 19 10½	34,000	452	2 8½	3789	4055	24 4	1319	11,650	69 10½	66⅔

NOTE.—On the 29th of September, 1848, the United General Gas Company handed over to the Devonport Gas Company their business, which amounted to 4,130,000 cubic feet per annum; and the increase in the year ending May 31, 1848, is partly owing to receiving the proportion of this increase for eight months.

Correspondence.

CROLL'S PATENT RETORTS.

SIR,—I observe in your Journal for the last month a communication with the above heading, in which the writer has fallen into a mistake, which I beg to correct.

It appears that, from a perusal of your Journal for the month of April last, he has received an impression that Mr. Croll proposes to make 4000 feet of gas in twenty-four hours from a 12½-inch D iron retort, 7 feet 6 inches long, instead of which, if your correspondent turns to page 45 of the number from which he has been quoting, he will there find in Mr. Croll's parliamentary evidence that the retorts from which he proposes to make that quantity are each 8 feet 6 inches long, one half in number being clay retorts, 15 instead of 12½ inches in diameter, *the* 4000 feet mentioned being an average of the working of retorts of this increased size.

Such being the state of figures, your correspondent's mind will, I hope, be more at ease regarding the danger your readers were in from their inability "to understand how circumstances modify cases, or to distinguish between facts given as the result of experience, and merely theoretical statements."

GEO. ANDERSON.

48, *Moorgate-street, London, Sept.* 24, 1849.

Register of New Patents.

CHARLES THOMAS PEARCE, Esq, of Park-road, Regent's-park, for "*improvements in apparatus for obtaining light by electric agency.*" Patent dated Feb. 16, 1849.

The following is the substance of Mr. Pearce's specification:—The first part of my invention relates to an apparatus consisting of a framing, which I prefer to be of wood; the lower part of this framing supports a clockwork movement enclosed in a case; on the top of the apparatus are seen the electrodes with their supports; a bar of carbon (forming one of the electrodes), the cross section of which may be cylindrical, triangular, or of other convenient form, the projecting edge or surface of which, when the sectional form is other than cylindrical, is presented to its fellow electrode, which is circular in form, that is, a disc, and revolves at the same time that the said bar of carbon is advancing upwards. In the drawing the disc is represented as being placed at an angle of 45 deg. With respect to the bar or rod of carbon, other angles may be given to the disc, but I prefer the one shown; a split sheath partly encloses and serves as a guide for the bar electrode. This sheath may be of metal, but I prefer glass for the purpose. To the top of the sheath is fixed a metal collar or ring (or supported to the framework or otherwise), into which are inserted three platinum wires, each furnished at their upper ends with iridium, which is fixed on the platinum wires by bringing them between the terminal wires of a galvanic battery, of sufficient intensity to fuse the iridium, the use of the iridium being to supply the current of electricity to the electrode, near to the portion where the light is evolved. A binding screw is provided, for making contact with the battery wire. The clockwork movement is so arranged that, through the medium of the wheels and rods described, at the same time that the bar electrode is caused to rise through its sheath by the same clock movement, motion is communicated to the disc electrode, suitable arrangements being provided for the purpose. Two cutters of iridium are attached by means of a metal spring to the framework; these press against the circular or disc electrode, and serve to cut off the redundant portions of carbon, and maintain a good presenting periphery for its next revolution.

Another mode of presenting the cage, or surface, of a bar electrode to another electrode is as follows:—I employ two circular electrodes in combination with one bar, the bar being placed between the two circular electrodes, or discs. The advantage of this mode of mounting the electrodes is, that if from any cause, such as the unequal waste of carbon, or irregularity of its surface, the light should be extinguished at one point, the other remains burning, until, by the further revolution of the disc, or the advance of the bar, the electrodes are again brought into contact, and the second point, or source, of light is restored. I have also employed three circular electrodes, in combination with one bar, the bar presenting three angles or surfaces to the circular or disc electrode. Thus an advantage is gained over the apparatus hitherto employed, by presenting three several centres of light, so merged as to appear as one only when used with a reflector, or reflectors, and the liability of the light to being extinguished rendered much less. Reflectors used may be of glass, or of metal; I prefer making them of copper, by electro-precipitation on a mould, or matrix, prepared of the proper form. By this method an unlimited number of reflectors may be made of the same exact form, and at a less cost than that of manufacturing in the ordinary way under the hammer. Having precipitated the copper on matrices with polished surfaces, I afterwards silver the surfaces by electro-precipitation. The cover of the glass shade enclosing the apparatus is furnished with a syphon tube at its upper surface, to allow the gaseous products of the combustion of the carbon to escape into a vessel containing water, or other liquid. I would remark that, although I prefer to use bar electrodes with disc electrodes, two bar electrodes may be employed in an apparatus, in such manner as to cross each other at an angle; and then, by giving a slow progressive motion to each of the bars, a continuity of fresh surfaces of the electrodes will result.

An apparatus in which the use of clockwork is dispensed with consists in a stand or frame of wood, in the centre of which is fixed a split sheath; within this sheath is a solid rod, to the lower end of which lines are attached, passing upwards over two pullies, and descending to the weights. Resting on a solid rod is a bar electrode; at the upper end of the sheath are iridium supporting conductors, such as before described. To the frame is fixed an upright, with a slotted opening therein, which receives the stem of a jointed piece, supporting the upper electrode and its appendages. Two tubes are supported by the uprights from the frame, and furnished with joints. Three tubes of brass form enlarged parts of the said tubes, each containing a spiral spring, which, by means of rods, press on the pieces of carbon contained in the tubes, forcing them towards the lower electrode. To the upper tube is fixed a carbon holder, composed of metal and pipe-clay. A metal collar is fixed to the tube by means of a screw, carrying another metal collar, which is attached to it by three wires. To this metal collar is attached an earthen cone, which may be of pipe-clay, phosphate of lime, or other earthy substance difficult of fusion and hollow within, to receive the bar of carbon. The cone is contracted at its lower end to prevent the bar of carbon being urged on too rapidly; there are two holes in the cone, to receive the wires connected with the metal ring, admitting of their coming in contact with the carbon. For the springs in the tubes a falling weight may be substituted. The two lateral bars of carbon contained in the tubes are non-conducting carbon; the upper and lower bars of carbon are conductive. The battery being connected with the upper and lower electrodes, the current passes through them, producing, by the separation of the bars from each other, the required light. As the lower electrode becomes wasted by the action of the current of electricity, the weights urge it upwards, until it is checked by the lateral bars of carbon, which press on it near its upper end. When electrodes are required of considerable length, I graft together several pieces of carbon by either of the following methods:—In the ends of each piece I drill a cavity, into which I insert a piece of carbon, of a shape that will fit firmly into the hole, and long enough to project therefrom; this projecting part fits into a similar piece of carbon, and the two being brought together become firmly united as one piece. Another mode of grafting or joining together which I sometimes adopt is the following:—In the side of the bars I make a groove longitudinally, into which I insert a smaller bar or slip of carbon, which running in two or more bars, the whole become as one. Another mode of forming electrodes is, to combine together two or more pieces of conducting and non-conducting carbon, so that the surface presented to the action of the current shall be of conducting matter, while the rest of the electrode shall be of non-conducting matter. This I accomplish either by the insertion of one into the other by a groove or union of surface, or by any other efficient mode, to secure contact between the parts. What I mean by non-conducting carbon is ordinary charcoal; whilst that which is conductive has been subjected to a high temperature in a close vessel, as is well known to electricians.

Another, the second, part of my invention consists in an apparatus for restoring contact between the electrodes, and thus regulating and ensuring the continuance of currents of electricity in apparatus for obtaining lights, as it sometimes happens that a current of air, suddenly acting upon the light, may blow out the arc of flame, as in exposed situations, where not perfectly protected, by which the current will be interrupted. At one end of the lever is a short metal tube, into which is fitted a piece of carbon, or other suitable conducting material, shaped like a wedge, or of a convenient form; to the other end of the lever is connected a soft iron armature, to which is attached a spiral opening. The lever is kept in a fixed position while the current is passing round an electro-magnet, which holds the soft iron armature in contact. The instant the light is blown out, the battery contact being broken thereby, the magnet loses its power, and the spiral spring draws up the armature, and therewith the end of the lever, allowing the other end to fall, bringing the piece of carbon down between the electrodes; the circuit is by this means restored, which as soon as done, the magnet resumes its power, and, moving the piece of carbon up again, the light is restored.

Another, the third, part of my invention consists in regulating the duration of, and intervals between, the light for signal lights, light-houses, and other purposes, where an intermittent light is desired. This I effect in the following manner:—To one of the arbors of a timekeeper I affix a wheel, composed of conducting and non-conducting material—say brass and ivory alternately—and having other suitable appurtenances. As the wheel is carried round by the clockwork, the insulating portions and the metallic portions are alternately brought in to contact with the battery by means of a spring. The spaces between the metallic portions are of a suitable width to the required intervals of time.

In applying this regulating principle to apparatus giving light, one of the electrodes is alternately made to approximate to, or recede from, the other, by means of an electro-magnet, which, being under the influence of the same current, keeps the electrode in its proper position whilst the current is passing, and the light maintained. The instant contact is broken by the wheel, the magnet loses its power, and the electrode recedes from the other; when contact is again restored, by the further movement of the wheel, the electrode as quickly resumes its proper position by the action of the magnet. A like apparatus is used to obtain more uniform action of currents of electricity by being the means of alternating the times of use of two or more batteries, in such manner that the time of giving light by means of each battery shall be regulated. When a battery has been kept in action for some time it has been found that the current fluctuates considerably, and the amount of electricity given off is much diminished, which is restored by breaking contact of the poles. I do this by the application of an apparatus similar to that last described, in conjunction with two or more galvanic batteries, so that each is put into and out of action alternately. The galvanic battery being charged, one of its wires is connected with the wire of a temporary or electro-magnet; the other wire of the battery being connected with one of the electrodes, the other electrode is connected with the other wire of the magnet. The carbon electrodes being

placed in contact, and the currents passing, the magnet is deflected, at the same time moving a toothed wheel, and through the train the electrode from its fellow-electrode to a certain distance, according to the amount of battery current passing.

Another part of my invention consists in an improved mode of constructing galvanic batteries, by which, firstly, the fluids employed therein are more equably supplied to each cell, and more readily removed, as they become unfit for use by continued action. The trough, known as Massi's perfluent, has been long used, and improvements therein have been made and claimed, in a recent patent, by Mr. Staite; in all of which there is an objection, on account of the fluid in some of the cells of the battery being of greater strengh than in others in the same battery, giving rise to unequal action in the series, and consequent loss of power. My improvements under this part of the invention consist of an arrrangement by which each set of plates (metallic elements) may be removed at once, instead of every plate singly, and of an arrangement by which the diaphragms form part of the trough, instead of being placed singly and separately in the cells. In this battery the fluids are supplied to each cell at the same time; and instead of the fluids being admitted at one end, and travelling to the other end, they are admitted at the side of each cell directly, instead of indirectly, from cell to cell. When only one fluid is employed as the excitant, it is admitted at the upper part of each cell, equally and simultaneously, by means of the trough, or cell, communicating with the cells by openings therein. The fluid, as it becomes saturated with the metal employed, is made to pass out of the battery on the opposite side, near the bottom, through openings into the outer trough, from which it passes into a receiver, which may be a cask, cistern, or any other convenient vessel. Where two fluids are employed, as sulphuric acid in the zinc cell, and sulphate of copper in the negative or copper cell, the acid solution is supplied above, as described for a single fluid battery; while the metallic solution is admitted below, and, rising as its specific gravity is diminished, passes out at the opposite side through the cell or trough, out of which it again passes into a vessel containing crystals of the salt employed, where it is renewed, and passes on to the next battery, which is placed at a lower level than the first.

In batteries where concentrated acids are employed, as the nitric or nitro-sulphuric, in the Maynooth battery, or that of Grove, the diaphragms, or porous partitions, are necessarily made of porous earthenware. In other batteries, where the fluids employed are less corrosive, such as Daniell's battery, I prefer diaphragms made of sycamore wood, cut into leaves, or thin plates, and boiled in an alkaline solution, as potash. I prefer for this purpose muriate of soda on account of its cheapness. The process of boiling the wood extracts the gum resins, and renders it conductive. After being boiled, I soak them in cold water, acidulated with sulphuric acid, in the proportion of 1 part acid to 30 water. Other sorts of wood may be employed for making the diaphragms, but I prefer sycamore. Other fluids may be employed; thus, where a current of voltaic electricity is required to be kept up for several days or weeks consecutively, I prefer employing alkaline solutions, such as the muriates of ammonia, soda, or potash, or the sulphurets of lime, potash, or soda. The advantage of employing alkaline solutions over acids is, that the zinc employed therewith does not require to be amalgamated with mercury, as is the case where acids are employed.

Having thus described the nature of my invention, and the manner in which the same is to be performed, I would remark I do not confine myself to the details herein shown and described, so long as the peculiar character of any part of my invention be retained; but what I claim is—first, the so employing bar electrodes, that the light shall be developed at the sides, or edges, in place of at points at the ends of such electrodes. I also claim the mode of using bar electrodes when in combination with disc electrodes, that the planes of the disc electrodes shall be held at an angle to the bar electrode used therewith.

I also claim the mode of causing the electric currents to be conducted near the point of bar electrodes, where the light is developed by employing holders, such as described. I also claim the means herein described for connecting, joining, and combining parts of bar electrodes; and I also claim the mode of employing bar electrodes, whereby a constant supply of non-conducting matter is kept up, to retard the approach of the bar electrodes employed.

Secondly: I claim the mode of regulating currents of electricity in apparatus for producing light, whereby, in the event of the light going out, contact shall be reobtained by the introduction of a conducting substance, to be removed by means of an electro-magnet, bar, or coil.

Thirdly: I claim the use of clockwork for regulating the time of the apparatus, giving light as herein described; and I also claim the use of clockwork for regulating the times the separate galvanic apparatus shall be the means of giving light.

Fourthly: I claim the mode of regulating currents of electricity produced by a battery, by employing a magnetic bar or coil as described.

Fifthly: I claim the improvements herein described, of perfluent or maintaining batteries, applicable to the purposes of obtaining light.

HENRY CROSLEY, of the firm of H. Crosley, Son, and Galsworthy, of Emerson-street, Surrey, engineers and coppersmiths, for "*certain improved modes or methods of, and apparatus for, heating and lighting, for drying substances, and for employing air in a warm or cold state for manufacturing purposes.*" Patent dated Feb. 28, 1849.

Claims.—1. An apparatus for heating water and other fluids.

2. A method of constructing boiler and other furnaces with rows of pillais of firebrick, two, three, or more placed immediately behind the fire-bars, and with air passages leading from the top of the brick-work to beneath the fire-bars.

3. A method of generating steam of low pressure by the application of steam of high pressure, as also a self-condensing box used in connection therewith.

4. A method of heating sugar-pans by means of a moveable furnace mounted on wheels.

5. A gas-heating stove, in the peculiar arrangement and combination of parts of which the same consists.

6. A gas-exhausting apparatus, in so far as regards the employment of two valved pipes or compartments, one for the inlet and the other for the outlet of the gas, such pipes or compartments being within a vessel immersed in water, and the vessel covered over at top by an inverted vessel; and in so far also as regards the mode of occasionally closing the said pipes or compartments at their lower ends by columns of water or cocks, for the application of certain parts to the said apparatus, and to other apparatus partaking of the same nature, and to measuring and registering the gas which passes through it.

7. A governor used in connection with the apparatus last described, and also the application thereof to gas-exhausters generally.

8. Three rotary or wheel gas-exhausters, each in the peculiar arrangement and construction of parts of which the same consists.

9. A moveable or divergent gas stove, in so far as regards the construction of means by which the light and heat generated by the combustion of the gas may be directed to and concentrated upon any particular part or parts of an apartment.

10. A divergent coal fire stove, and also a revolving coal fire stove, with revolving reflector or shield.

11. A "Concentric Gas-burner," and "Conical Concentric Gas-burner," each in the peculiar arrangement and construction of parts of which it consists.

12. A gas-burner, in so far as regards the employment therein of jet pipes (two, three, four, or more), so shaped and placed that the streams of gas issuing therefrom shall be ejected obliquely towards the centre of the burner, and impinge against or run into one another; and also of a bottom shade closed against any access of air from beneath (the usual glass chimney being dispensed with). And farther, the application of the close-bottom shade to all other gas-burners to which the same may be applicable. And also a certain modification of the burner.

13. Three peculiar gas-burners described in the specification, in so far as regards the means provided in each for diminishing or enlarging the aperture through which the gas escapes.

14. A candle, which is denominated "Argand," and also an "Argand Candle-lamp," in so far as regards therein the combination of a hollow wick with apertures in the basement for the admission of air into such wick. And also the employment in candles generally of hollow wicks made of vegetable fibrous materials, intertwined or otherwise combined with threads or filaments of zinc or other soft metal or metallic compounds.

15. An improved whirling apparatus for drying substances, in so far as regards the means therein employed to give a reciprocating rotary motion to the hollow cylinder; that is to say, a rotary motion first in one direction and then in another.

16. Several methods of applying air in a warm or cold state for manufacturing purposes, each in the peculiar arrangement, combination, and adaptation of parts of which it consists; and also improvements in an air-wheel formerly patented by Mr. Crosley.

17. The application of the improved air-wheel to the purification of coal gas.

NATHAN DEFRIES, of Grafton-street, Fitzroy-square, C.E., and GEORGE BROOKS PETIT, of Brook-street, New-road, Middlesex, gas engineer, for "*improvements in applying gas to heat apparatus containing fluids, and in heating and ventilating buildings; also improvements in gas fittings, and in apparatus for controlling the passage of gas.*" Patent dated March 5, 1849.

Mr. Defries has disclaimed all the above title, excepting—"Improvements in applying gas to heat apparatus containing fluids, and in heating and ventilating buildings."

The first improvement is in the method of applying gas to heat baths. The bath has a double bottom, the upper one plain and the lower corrugated, and, being corrugated, presents a larger surface for the absorption of heat emitted by gas-burners placed below it than if plain.

The second improvement consists in applying the heat evolved from gas lights, when used for illuminating purposes, to heating fluids. The heated products of combustion are conveyed by pipes to any convenient spot. Around these are other pipes containing the fluid to be heated, which may be drawn off as required; or it may be made to circulate in pipes for heating apartments.

Claims.—1. The employment of gas, in the manner described, for heating baths.

2. The employment of the heat evolved from gas used for illuminating purposes to heat fluids.

CHARLES GORE, No. 3, New Charles-street, City-road, London, for "*a gas exhauster.*" Registered Sept. 19, 1849.*

The drawings accompanying the registered description of this invention are necessary to any explanation of its operation. It bears some resemblance to Mr. Evans's exhauster; but the inventor states that the discharge at each revolution is double the content of the cylinder, and that, consequently, it does not require to be driven at the same speed as other machines of this nature.

THOMAS HENRY RUSSELL, of Wednesbury, patent tube-manufacturer, and JOHN STEPHEN WOOLRICH, of Birmingham, chemist, for "*improvements in coating iron and certain other metals, and alloys of metals.*" Patent dated March 19, 1849.

These improvements consist, firstly, in coating iron by the metal cadmium, either with the aid of electricity, galvanism, or the magneto-electric machine, or by immersion in a hot bath of the metal.

When the coating is to be effected by the means of the galvanic

* Manufactured by H. and M. D. Grissell, Regent's Canal Iron Works.

trough, a precipitate of cadmium is first formed, which is then dissolved in a solution of the cyanate of potassa. The articles to be coated are immersed in the solution and treated in the usual manner now practised in coating metals by the aid of the galvanic battery. The positive wire should terminate in a plate of cadmium, and that should surround or be placed at a few inches from the surfaces to be coated.

When the articles are to be coated by immersion in the molten metal, then a portion of tin is to be added to the cadmium. The articles are cleaned by dipping in dilute acid, and then plunged into the melted metal; being kept in which for some time, the surfaces will become coated. The surface of the melted metal is kept covered with oil or tallow, to prevent the action of the oxygen of the atmosphere upon it.

Articles made of iron may be protected by being partially covered with cadmium, such as screw-propellers, &c.

The patentees describe, secondly, certain methods of coating metals with copper by the aid of the soluble acetates, benzoates, and cyanates of potasssa.

Claims.—1. The coating of metals or alloys of metals with cadmium, or alloys of cadmium, and the partially covering of articles to be protected with cadmium.

2. The coating of metals with copper or alloys of copper, by means of the soluble acetates, benzoates, and cyanates of potassa.

William Parkinson, of Cottage-lane, City-road, Middlesex, gas-meter-manufacturer, successor to the late Samuel Crosley, for "*improvements in gas and water meters, and in instruments for regulating the flow of fluids.*" Patent dated March 20, 1849.

1. Mr. Parkinson's improvements in gas meters consist, *firstly*, in supplying the meter with water through a chamber shut off from the rest of the instrument, the mouth of which chamber is placed at an elevation *above* the proper or measuring level of the water inside; and *secondly*, in placing the mouth of the overflow or waste pipe at or about the centre of the area of the water. By these arrangements the following valuable results are obtained:—No more than the proper quantity of water can be introduced into the meter under any circumstances, because, as soon as there is the least escape, it flows over into, and is discharged by, the waste-pipe—the mouth of which, being placed in the centre of the area of the water, is beyond the reach of being tampered with from the outside. Neither can any water be abstracted by a syphon or otherwise, from the interior of the meter through the supply aperture (the course usually adopted by fraudulent consumers), because there is no communication between the water of the supply chamber and the water in the inside of the meter. As little can any gas be stealthily abstracted through the water supply-pipe (another of the devices of dishonest meddlers), because the only gas which can be reached at through that aperture must be gas which has passed through the drum, and been already registered against the consumer. Again, should the meter happen not to be set on a perfect level, or the level become changed by a depression of the bearings from time or accident, the level of the water will, in consequence of the central position of the mouth of the waste-pipe, be obviously much less affected than where the mouth is, as usual, close to the side. And thus, while the proper measuring water-line of the meter can always be readily adjusted to afford any needful protection to the consumer, the gas-supplying companies may place the fullest confidence in the perfect correctness (within commercial limits) of the quantities registered.

2. Mr. Parkinson's water meter is an improved adaptation of the wheel or drum used in the ordinary gas meter, to the purpose of measuring and registering the quantity of water drawn from, or delivered by, any source of supply.

Stephen White, Victoria-place, Bury-new-road, Manchester, gas engineer, for "*improvements in the manufacture of gases, and in the application thereof to the purposes of heating and consuming smoke; also improvements in furnaces for economizing heat, and in apparatus for the consumption of gas.*" Patent dated March 26, 1849.

This invention relates principally to the construction and arrangement of apparatus for the production of what is termed water gas, and which was the subject of a former patent granted to Mr. White. This gas is composed of a combination of carburetted hydrogen gas with hydrogen gas and oxide of carbon gas—the result of the decomposition of water by contact with charcoal, coke, or anthracite coal, mixed with small particles of iron or lime, heated to a high temperature.

The apparatus first specified is constructed of a material capable of bearing the greatest heat that can be obtained (white red), and consists of two vertical retorts placed in an oven over a furnace. Inside each retort there is a flue which communicates at bottom with the furnace, and at top with the oven. The products of combustion ascend the flues and pass into the oven, so that the retorts and their contents are heated both inside and outside. They are filled with small pieces of charcoal, coke, or anthracite coal, and thin plates of iron or pieces of thin iron wire, and their covers at top, by which these materials are introduced, luted and securely fastened down, so as to render them perfectly gas-tight. Water is caused to fall in a succession of drops, or in a small stream, into syphon pipes, which conduct it on to the top of the materials through which the gas thus generated descends to the bottom of the retorts, whence it escapes into horizontal retorts (also placed in the oven), and there meets and mingles with carburetted hydrogen gas; which is generated in the following manner:—A quantity of resin and gas, or of tar or fat, or other substance rich in carbon and olefiant oil, is melted in a vessel, fixed on the top of the oven, and allowed to flow in a liquid state into the horizontal retorts, which are each divided into two or more compartments by horizontal partitions extending nearly to the end. These compartments are filled with copper or iron chains, or pieces of wire twisted into a spiral form, so as to offer a heated and partial resistance to the passage of the gas to the hydraulic main. When pit-coal is employed instead of resin, as the hydrocarbon, it is placed in the horizontal retorts, and the employment of the other parts of this branch of the apparatus dispensed with, care being taken to allow sufficient passage for the gas resulting from the decomposition of water, to mix with the bicarburetted hydrogen gas produced by the distillation of coal.

The chains are to be occasionally taken out of the horizontal retorts, for the purpose of freeing them from the carbon which may adhere to them.

The proportion of iron to coke in the vertical retorts should be as 1 : 6, and the quantity of materials in the vertical and horizontal retorts should be so regulated with regard to one another that the proportions between the volume of the gas evolved by the decomposition of water, and that of the gas resulting from the distillation of coal, may be as 4 : 6. The gas should be tested in its passage to the gasometer by a test-burner; and if it burns with a bright smoky flame, more water should be supplied to the vertical retorts; but if it burns with a faint blue flame, then more of the liquid hydrocarbon should be supplied to the horizontal retort.

2. The patentee proposes to manufacture oxygen gas for illuminating purposes by employing the nitrate of soda or of potassa. Two or more detached moveable crucibles, partially filled with either of these materials, are placed in a retort, which is heated in the ordinary manner. The number of retorts employed may be varied according to the wish of the operator and the capacity of the oven. The oxygen and nitrous fumes disengaged ascend into the hydraulic main, which contains water or lime-water. The oxygen is conducted to an apparatus where it is freed from aqueous particles, and thence to the gasometer. The nitrous fumes are absorbed by the water in the main, and form nitric acid, which is drawn off as may be deemed necessary. The residua in the crucibles form carbonate of soda or potassa, according to the substance first used, which are valuable as articles of commerce; or they may be treated with nitric acid diluted with twice its volume of water, after which the water is to be evaporated. The residua will be either nitrate of soda or potassa, which may be used again.

The improvements in heating and consuming smoke consist in causing currents of the water gas, and of atmospheric air or oxygen, to meet and burn in a suitable vessel behind the bridge of the furnace.

Claims.—1. The mode of combining and arranging the parts of the apparatus, and the mode of constructing the horizontal retorts with a division or divisions, to extend the heating surface in contact with which the generation of carburetted hydrogen gas, and its combination with the hydrogen gas and oxide of carbon gas, take place.

2. The mode of manufacturing oxygen gas by exposing the materials from which it is to be obtained to heat in detached and moveable retorts, of suitable construction, heated in the ordinary manner.

3. The application of gas evolved by the decomposition of water combined with atmospheric air or oxygen to produce heat, or with atmospheric air to consume smoke, by a current of it being directed into the flues through which the smoke passes.

David Henderson, of London Works, Renfrew, Scotland, engineer, for "*improvements in the manufacture of metal castings.*" Patent dated March 26, 1849.

1. In a new method of manufacturing a particular class of metal castings, viz., that in which the whole, or a considerable portion, of the casting is of uniform section, as in the case of pipes, whether straight or curved columns, girders, gutters, ridges, cornices, rails, shafts, and other similar castings.

2. In a new method of manufacturing certain descriptions of circular work, such as pans and basins.

3. In the production of more than one casting from the same mould, when such moulds are made as hereinafter described; and I would remark, that my invention is particularly applicable to the manufacture of castings of iron, but may also be used for other metals.

The principal part of the casting-box is made in two parts, divided lengthwise, and, when joined, is cylindrical, except where required to be swelled out for the socket, or for flanges, or other projections; and thus a uniform thickness of sand, or as nearly so as may be, is employed throughout the entire mould. The parts of the box have a number of small holes through them, to allow the gases to escape from the mould when the melted metal is poured in. I call this form of box a close mould-box, to distinguish it from the ordinary boxes, which are open at the back, and are rammed from the back. In this close mould-box the back affords a firm support to the sand or loam, but admits of the escape of air and gas. The meeting edges are made flat by planing or filing, so as to fit quite close, and are carried inwards, until the width between them is equal to the diameter of the pattern, forming lips, which are made thin at the edge, so as to present a small surface to the action of the metal during the operation of casting, these edges or lips being made to follow the external form of the pipe throughout; but, as shall be afterwards shown, it is not always necessary to allow the metal to come in actual contact with these lips, but in some cases they are made to admit of a portion of sand between them and the casting. The lower end of the box is fitted to rest on a plate which supports the core, and at the upper end is fitted to receive a separate circular box, which closes in and completes the upper part of the mould, and forms the gate-box, in which a basin and passages for the metal are formed in sand, and by which the metal is introduced to the mould. In preparing the mould, two pieces of pattern are required—one for the socket, and another for the body or straight portion of the pipe; and I call this description of pattern a short-part pattern, it being shorter than the body of the pipe, and only representing a part of circumference of the pipe. In the case of pipes, I generally make this short-part pattern to represent half the circumference of the pipe, but it may sometimes be advantageous to make it only one-third part, using three longitudinal mould-boxes instead of two. The pattern and mould-boxes may be still further subdivided, but in genral two boxes will be found most convenient.

The ramming up of the mould is commenced by introducing the socket pattern, and fixing it by clamps or screws; the sand, or loam, is then rammed, or filled in, behind the pattern from the upper or open end. The pattern of the body is then applied, before the socket pattern is removed, and, being secured as before described, the sand is rammed in as before; the pattern is then slid a short distance along the box, and again rammed up behind, and so on until the entire box is filled. If a bead be required at the upper, or spigot, end of the pipe, the box is made so that one half of the bead shall be formed in it, and the other half in the gate-box. The upper end of the pattern may be made with a bead, to serve as the pattern for the lower part of the bead on the pipe. The upper part of the bead is readily moulded in the gate-box on a separate board, generally called an odd-side board, or laying-down board, as is well understood. The core may be formed by any of the usual methods, with a plate at bottom, which fits the mould-box and keeps the core exactly central in the mould; this plate is covered with loam, and serves to close the bottom of the mould. In large pipes this is sufficient for adjusting the core in the mould at top as well as bottom; but, when the plate is small, the gate-box is made to embrace a central rod of the core, and, as the gate-box fits the top of the mould-box, the core is hereby adjusted, and held securely in the centre of the mould. As an additional means of adjusting the two parts of the mould-box, guide pins may be applied. The different parts of the mould are held together by clamps, screws, or bolts. Previously to their being joined for casting, the parts of the box and core are dried; but the gate-box may be prepared with ordinary green sand. When the mould is formed of green sand it does not require drying. It is not necessary that the pipe should in all cases be cast with the socket downwards, the principle being equally applicable to its being made at the upper part of the mould; and flanges, or other projections, may be made on the pipes, in a similar way to that already described for sockets.

For bend pipes, the box is somewhat similar to those already described; but the meeting edges of the two parts of the box are curved, so as to make the joining along the centre line of the curve of the pipe. In section, the box is precisely similar to that already described for straight pipes; but the short-part patterns are curved, and require curved plates for sliding on the edges of the box. The gate-box may be dispensed with, the basin and gates being formed in the upper end of the mould-box, which is swelled out for this purpose. The lower half of the box is supported in an upright position by its foot; the core is then laid into its place, being properly supported at the top and bottom, and held securely in its place by a clamp. The upper half of the box is then applied, guided to its proper position by the guide pins, and secured to the lower parts by bolts, or clamps; the metal is poured into the mould by the cup or basin, and passes through suitable openings to the interior of the mould. Another method of ramming a mould-box, which has not got close fitting edges all along, and is made without the thin edges or lips approaching the pattern:—The parts of the box merely require to fit at several points on the meeting edges, which are made fair and out of winding at these points, so as to lie solidly together; and to guide the pattern, two guides, the full length of the box, are fixed temporarily to its sides, with their upper and straight edges exactly flush with the fitting portions of the box; and to make the pattern move in a straight line along the box, the outside, as well as the upper edge, of the guide is made perfectly straight.

In mould-boxes for gutters, the same principle of moulding is applied—different short-part patterns being employed for the upper and lower halves of the mould. For retorts, bearing rails, and grooved rollers, the above may be applied with suitable modifications.

I will now proceed to describe the second part of my invention, to make a circular basin, or pan. The mould-box is in two parts—the external and internal part—both formed so as to have a regular thickness of sand, or nearly so, throughout, and fitted to each other. The external mould-box is made with a lip, fitted to form the edge of the pan; in the centre of the box a socket is formed to admit a pin on the pattern; this pin is adjusted by collars, and a cotter, so as to be held steadily in the socket, and at the same time admit of its turning freely round. The pattern has its surface made exactly of the form of the inside of the mould; the upper end is made to work in the fitted part of the box. It is temporarily fixed while being rammed up behind the screw, and as the ramming up proceeds it is turned round gradually—being supported on its centre at one end, and on the fitted edge of the box at the other end; and the mould is thereby made perfectly circular. After the pattern is removed the opening in the centre, left by the pin, is filled with sand; the other half of the box is rammed in a similar way with a reverse pattern. The two parts are joined, and a basin and gates for the metal formed. This arrangement may be modified by having the patterns to extend across the box with guides to work on the fitted portions, so that the centre pin will not be required. In commencing the formation of the mould the sand should be rammed under the pattern from both sides simultaneously, or a board should be placed on one side of the pattern to confine the sand, whilst it is rammed in from the other side. When the mould is nearly complete the pattern is shifted on one side, and the mould finished by hand, and adjusted by again bringing the pattern over it. The moulds may be made of green sand, dry sand, or loam.

The third portion of my invention relates to the use of a mould, formed as already described, for the making of several castings in succession, without the necessity of ramming and drying a new mould for each one—an application particularly suitable for pipes and other plain castings, which deliver easily from the mould. For this purpose I form the mould of dry sand or loam. After the metal has been poured into the mould, and fairly set, the box is carefully removed from the casting—the projecting edges, or lips, of the box supporting the sand, and assisting its removal. The coating of blackwash, usually applied to dry sand moulds, is rubbed off, and any damage which the sand may have sustained made good with fresh sand, and another coat of blackwash applied, while there is yet enough heat in the mould to dry it thoroughly. A fresh core, if the mould be for a pipe, is then set down, and the mould-box closed round it, and the casting proceeded with as before.

Having described the nature of my invention, and the manner in which the same is to be performed, I wish it to be understood that I am aware that short moveable patterns have already been used for making moulds for casting; and, therefore, I do not claim the use of such patterns, except as herinafter mentioned; but I claim as improvements in the manufacture of metal castings:—

Firstly. The manufacture of pipes, columns, girders, gutters, ridges, cornices, rails, shafts, and other similar castings in moulds formed by means of a short-part pattern guided by the mould-box, or by a guide attached thereto, and moved gradually along during the process of ramming or filling the mould-box, as above described.

Secondly. The manufacture of pipes, columns, girders, gutters, ridges, cornices, rails, shafts, and other similar castings, by means of moulds formed in close mould-boxes, with lips fitted to the form of the article to be cast, as above described.

Thirdly. The manufacture of pipes, columns, girders, gutters, ridges, cornices, rails, shafts, and other similar castings in moulds formed in close mould-boxes, with lips fitting to the form of the article to be cast, such moulds being formed by means of short-part patterns, guided by the boxes, or by guides attached thereto, as above described.

Fourthly. The manufacture of pans, basins, and similar circular castings in moulds formed in close mould-boxes, with lips fitted to the form of the article to be cast, when such moulds are formed by means of a moveable part-pattern, as above described.

Fifthly. The use of moulds formed, as described in my first, second, third, and fourth claims for making two or more castings in succession, without destroying the whole of the mould, as above described.

Miscellaneous News.

Novel Mode of Manufacturing Illuminating Gas.—A very interesting experiment was recently tried by MM. Livenais, of Bordeaux, and Dr. Berhardt, at the chemical lectures of the faculty in Paris, in the presence of several members of the Academy, and many other *savans* and manufacturers. The fact to be demonstrated was, that, by the decomposition of grape-skins and wine-lees in a close vessel, carburetted hydrogen gas would be disengaged of such a superior quality as to lead to the supposition that it might be used with advantage in place of the gas ordinarily obtained from coal and resin. Half a kilogramme (about 1 lb. English), upon being put into an incandescent retort, furnished in less than seven minutes 200 litres (a litre equals about a quart English) of carburetted hydrogen gas. This gas, on being supplied to a burner, burned with a bright-white light. It is entirely free from smell, and the flame may be raised to a great height without smoke. A second experiment made with dried wine-lees gave an equally satisfactory result. By this simple means any one may manufacture his own gas in his own house at a very trifling expense.—*Technologiste.*

The Holliday Light.—Court of Queen's Bench.—Holliday *v.* Fawcett.—This was an action to try the validity of a patent taken out by the plaintiff for improvements in Self-Generating Gas Lamps, which it was alleged the defendants had infringed. From the evidence it appeared that though several patents had been taken out for portable lamps, to burn gaseous or spirituous liquids without the use of wicks, none of them had succeeded in that object, so as to bring them into extensive use, until the improvements introduced by the plaintiff had removed the former defects; and that since those improvements had been effected the sale had been very great: and the utility of the new lamp was so manifest, that many parties had commenced to make them without due licence. In support of the plaintiff's case, Wm. Carpmael, Esq., civil engineer, of Lincoln's-inn, stated that he had been much consulted on the manufacture of lamps for burning various matters, and, amongst others, for burning naphtha. He was well acquainted with all the different forms of the vapour lamp; and was aware that, until plaintiff's lamp was introduced, none of them had been successful to any extent. He was of opinion that the peculiar forms of the plaintiff's burners were new and useful. Evidence of the extensive sale of the plaintiff's lamp was also given, and the lamp itself exhibited in court in full action, producing, as Mr. Carpmael said, a very splendid flame, resembling that of a gas flame or burner. It was also shown that the defendant had, in the opinion of the witnesses examined, infringed upon plaintiff's patent; and, in support of their testimony, sections of each burner were produced. Counsel, in setting forth plaintiff's case, stated that the action was brought to assert the right of plaintiff, and not with a view of obtaining damages. The defence was that the patented improvements were not new; and, in support of this plea, evidence was adduced to show that a burner for a vapour lamp, similar to that claimed by the plaintiff, had been sold and invoiced to a party in the month of November, 1847, being nearly two months prior to the sealing of the patent. On examination, however, in court, the burner proved to be essentially different. Other witnesses were also called to state that they had made burners for vapour lamps, varying slightly from plaintiff's, before the patent, but did not produce any. The jury retired, and, on returning into court, gave a verdict for the plaintiff on both the points left to them by the judge. The judge's associate, on receiving the verdict, stated to the jury that, having found in favour of the plaintiff's *right*, it would only be necessary to specify a nominal sum, as the plaintiff had not made it a question of damages. The jury, therefore, found damages one farthing. The judge, upon being applied to, certified for costs, which the defendant will accordingly have to pay on both sides.

Share List.

THE PRICES QUOTED ARE THOSE AT WHICH THE LAST SALES HAVE BEEN MADE.

The Companies whose names are printed in italic type are incorporated by Act of Parliament.

Number of Shares issued.	Amount per Share	Name of Company.	Amount paid up per Share	Dividend per Cent. per Ann.	Price.
	£	**ENGLAND.**	£ s. d	£ s. d	£ s. d
		Aberdare			
		Abergavenny			
		Aberystwith			
		Abingdon			
		Accrington £5500		5 0 0	
		Alcester			
		Alford, Lincolnsh.			
		Alfreton			
		Alnwick			
		Alston Moor			
		Alton			
800	5	Altrincham	5 0 0		
		Amlwch			
		Ampthill			
350	10	Andover	10 0 0	5 0 0	10 0 0
		Appleby			
		Arundel			
		Ashbourn, Derby			
		Ashburton			
		Ashby-de-la-Zouch			
		Ashford, Kent			
		Ashton-under-Line £42,500		13 4 0	
		Atherstone			
		Axminster			
225	20	Aylesbury	20 0 0	5 0 0	20 0 0
		Aylsham, Norfolk			
		Bacup, Yorkshire			
		Bakewell			
		Baldock			
140	25	Banbury	25 0 0		
		Bangor			
500	5	Barking, Essex	4 10 0	5 11 0	5 0 0
250	10	Barnard Castle	10 0 0	5 10 0	10 15 0
		Barnet			
		Barnsley £6000		7 10 0	
100	20	Barnstaple	20 0 0	7 10 0	25 0 0
		Barton			
120	25	Basingstoke	25 0 0	8 0 0	28 0 0
2400	20	*Bath*	16 0 0	10 0 0	21 to 23
		Battle £2000		6 0 0	
56	26½	Bawtry	26 10 0	5 0 0	25 0 0
		Beccles, Bungay, and Lowestoft			
		Bedford			
		Belford			
		Bedale, Yorkshire			
		Belper			
		Beminster			
700	5½	Berwick-on-Tweed	5 10 0	6 8 0	5 15 0
		Beverley			
		Bewdley			
280	10	Bideford	10 0 0	6 0 0	10 10 0
		Biggleswade			
		Bicester			
		Bilston £25,000			
		Billericay			
		Bingley			
		Birkenhead and Claughton £56553	35 0 0	3 7 6	32 to 34
2400	50	*Birmingham and Staffordshire*	50 0 0	8 0 0	64 to 66
	25	*Ditto*, new shares	7 10 0	8 0 0	10½ to 11½
704	75	Birmingham	75 0 0	6 13 4	108 to 110
		Bishop's Auckland			
		Bishop's Stortford			
		Blackburn £24,000		8 0 0	
		Blandford			
		Blythe			
		Bodmin			
		Bolton £49,500		9 0 0	
		Boroughbridge			
		Boston £8000		6 0 0	
200	10	Bourn	10 0 0	5 0 0	
		Brackley			
		Bradford, Wilts			
		Bradford, Yorksh. £45,000		10 0 0	
		Brampton, Cumb.			
		Brandon, Suffolk			
		Brecon			
		Bridge-end, Glam.			
		Brierly Hill			
2250	20	*Brighton*	20 0 0	5 0 0	16 to 16 10
1125	20	,, new shares	16 0 0	5 0 0	
		Brighton and Hove £50,276			
4250	20	*Bristol*	20 0 0	10 0 0	37 to 39
1630	25	*Bristol and Clifton*	25 0 0	6 0 0	25 0 0
		Brixham			
		Braintree			
750	50	*Brentford*	50 0 0	6 0 0	46 to 48
800	25	,, new shares	11 0 0	6 0 0	11 0 0
		Brentwood			
		Bridgnorth			
		Bridgwater £6000		5 0 0	
400	10	Bridlington	10 0 0		8 0 0
		Bridport			
		Brigg			
		Broadstairs			
100	50	Bromley, Kent	50 0 0	6 0 0	52 10 0
		Bromsgrove			
120	10	Bruton	10 0 0	4 0 0	8 0 0
100	25	Buckingham	25 0 0	5 0 0	25 0 0
		Bungay (see Beccles)			
		Burford			
		Burlington			
		Burnley £19,946			
		Burslem			
		Burton-on-Trent			
		Bury St. Edmund's			
		Bury, Lancashire £6570			
		Buxton			
		Callington			
		Calne, Wilts			
		Camborne			
		Cambridge £32,000		7 0 0	
240	50	*Canterbury* Gas and Water	50 0 0	6 0 0	57 to 58
240	25	*Ditto*, second issue	25 0 0	6 0 0	25 0 0
		Cardiff £10,500		7 10 0	
		Carlisle £9000		8 0 0	
		Carmarthen			
		Carnarvon			
		Chapel on the Frith			
		Chard			
		Chatham (see Rochester)			
		Chatteris			
		Cheadle			
		Chelmsford			
		Cheltenham £17,242 10s.		8 10 0	
		Chepstow			
		Chertsey			
		Chesham, Bucks			
		Chester			
		Chesterfield £12,023 14s. 1d.			
240	25	Chichester	25 0 0	6 0 0	30 0 0
		Chippenham			
		Chipping Norton			
		Chorley			
		Cirencester			
		Clifton (Bristol and Clifton)			
		Cleckheaton, York.			
		Clitheroe			
		Cockermouth			
		Colchester			
		Colne, Lancashire			
		Coleford, Gloucest.			
		Coggeshall			
		Congleton £5000		7 10 0	
		Cowbridge			
800	25	*Coventry*	25 0 0	5 0 0	20 0 0
		Cowes			
		Crewkerne			
		Croydon			
		Cranbrook £1900		5 0 0	
		Crediton			
		Crewe, Cheshire			
		Darlaston			
		Darlington			
250	20	Dartford	20 0 0	7 10 0	27 0 0
		Dartmouth			
125	20	Daventry	20 0 0	6 0 0	24 8 0
		Dawley, Shrop.			
		Dawlish			
500	6	Denbigh	6 0 0	5 0 0	6 0 0
820	10	Deptford, Bermondsey, and Rotherhithe	10 0 0	5 0 0	4 10 0
		Derby £16,250		7 10 0	
90	20	Dereham (East)	20 0 0	4 10 0	
1000	5	*Dewsbury*	5 0 0	7 10 0	8 12 6
		Devizes			
4000	5	*Devonport*	5 0 0	6 0 0	5 14 0
		Diss			
		Doncaster			
280	25	Dorchester	25 0 0	5 0 0	25 0 0
120	25	Dorking	20 10 0	5 0 0	21 10 0
		Douglas, Isle of M.			
209	56½	*Dover*	56 10 0	6 0 0	56 10 0
		Downham			
		Driffield			
		Droitwich			
600	20	*Dudley*	20 0 0	4 0 0	14 to 16
		Dunmow			
		Dunstable			
		Durham			
276	9	Dursley, Gloster	9 0 0	5 10 0	8 0 0
		Elland			
		Ellesmere			
300	19	Epsom	19 0 0		
		Evesham			
		Exeter £40,000		8 0 0	
		Exmouth			
		Eye, Suffolk			
		Fakenham			
		Falmouth			
		Fareham			
120	25	Farnham	25 0 0	10 0 0	42 0 0
		Farringdon			
		Faversham			
		Fleetwood			
		Folkestone			
		Frome			
		Gillingham, Dorset			
		Glastonbury			
		Glossop £6000		7 0 0	
		Gloucester £24,600		7 10 0	
		Gomersal			
		Godalming			
		Gosport			
		Grantham			
		Gravesend			
1000	10	*Great Grimsby*	6 10 0	8 0 0	8 5 0
		Guildford			
		Guisborough			
		Hadleigh			
		Hales Owen			
300	6	Halesworth	6 0 0	7 10 0	5 10 0
		Halifax £15,000		8 0 0	
		Halstead			
		Harleston			
		Harrogate £10,000			
		Hartlepool £7835		7 0 0	
		Haslingden, Lansh.			
330	50	Hastings and St. Leonard's	50 0 0	6 0 0	60 0 0
		Haverfordwest			
		Haverhill			
		Haworth, Yorks.			
		Helstone			
		Hemel Hempstead			
300	10	Henley-on-Thams.	10 0 0		
		Hereford £5300		4 0 0	
		Herne Bay			
270	10	Hexham	10 0 0	7 0 0	12 0 0
		Heywood £10,000		7 10 0	
230	10	Hinckley	10 0 0	5 0 0	7 0 0
		Hindley, Lancash.			
		Hitchen			
		Hythe			
		Holbeach			
		Holmfirth £8325		6 0 0	
		Holyhead			
		Holywell (see British Provincial)			
		Honiton			
		Horncastle			
10		Houghton-le-Sprg.	10 0 0	8 0 0	
		Horsham			
		Howden			
		Hull, Sculcoats (see British Provin.)			
		Hull, Broadley-st. £11,712. 10s.		8 0 0	
		Hungerford			
		Huddersfield			
520	5	High Wycombe	5 0 0		5 0 0
		Hyde, Cheshire			
		Ilminster			
		Ilford			
		Ilfracombe			
		Ironbridge			
1400	10	*Ipswich*	10 0 0	8 0 0	15 0 0
1400	10	,, new shares	5 0 0	8 0 0	
800	25	*Isle of Thanet* (Ramsgate&Mar.)	20 0 0	5 0 0	19 to 20
		Kendal £7600		7 10 0	
		Kenilworth			
		Keswick			
100	25	Kettering	25 0 0	5 0 0	25 0 0
		Kiddermins. £8000		5 0 0	
		King's Langley			
		Kington, Hereford			
		Knutsford			
		Llanelly			
		Llandovery			
		Leamington Priors £20,000		6 0 0	
		Ledbury			
		Leeds Old Comp. old stk., £60,300		10 0 0	
		new ,, £11,527		6 0 0	
		Leeds New Comp.			
		Leek			
		Leicester		7 0 0	
		Leigh			
125	20	Leighton Buzzard	20 0 0	5 0 0	
		Leominster			
		Leyburn, Yorksh.			
		Liskeard			
330	25	Lewes	25 0 0	5 0 0	23 0 0
		Lincoln £8000		10 0 0	
		Leyland, Lancash.			
250	20	Lichfield	20 0 0	7 10 0	27 10 0
		Liverpool United	100 0 0	10 0 0	146 to 148
		,, ¼ sh.	25 0 0	10 0 0	32 to 34
		Langport			
		London Comps.—			
5000	40	*British*	18 0 0	5 11 1	13 to 15
		,, debentures		4 0 0	
5000	20	,, Prov.—(Ayr, Clonmel, Gloucester, Holywell, Hull, Norwich, Stoke, Trowbridg)	20 0 0	7 0 0	19 to 21
	20	,, Prov., new	3 0 0	7 0 0	3 to 3¼
	25	*Commercial*	25 0 0	5 10 0	25¼ to 26¼
	25	,, new shres	10 0 0	5 10 0	pr.to¼pm.
	25	,, ,,	2 10 0	5 10 0	pr.to¼pm.
12,000	50	*Chartered*	50 0 0	6 0 0	44 to 46
6000	50	,, new shares	10 0 0	6 0 0	9 to 9¼
1000	100	*City of London*	100 0 0	10 0 0	240 0 0
1000	100	,, new shares	75 0 0	10 0 0	210 0 0
4000	50	*Equitable*	50 0 0	4 10 0	26 to 30
10,000	20	European—(Amiens, Boulogne, Caen, Havre, Nantes, and Rouen)	20 0 0	5 0 0	9 to 10
8000	50	*Impl. Continental*—(Amsterdam, Aix-la-Chapelle Antwerp, Berlin, Bordeaux, Brussels, Cologne, Frankft., Ghent, Haarlem Hanover, Lille, Marseilles, Rotterdam, Toulouse, Vienna)	42 0 0		30 to 35
7000	50	,, new shares	38 0 0		38 to 40
	50	,, third issue	42 10 0		52 to 55

Number of Shares issued.	Amount per Share	Name of Company.	Amount paid up per Share	Dividend per Cent. per Ann.	Price.
	£		£ s. d	£ s. d	£ s. d
10,000	50	*Imperial*	50 0 0	6 0 0	65 to 67
		„ debentures			
4000	40	*Independent*	40 0 0	6 0 0	60 to 62
3000	50	*London*	50 0 0		10 to 15
3000	50	„ preference	50 0 0		20 to 25
9000	50	*Phœnix*	47 0 0	5 0 0	27 to 29
320	50	*Poplar*	50 0 0	4 0 0	28 to 30
1600	100	*Ratcliff*	90 0 0	5 0 0	73 to 75
4000	25	*South Metrop.*	25 0 0	6 0 0	21 to 23
9000	50	United General—(Cork, Dublin, Limerick)	50 0 0	2 10	14 to 16
12,500	20	Western	10 0 0		
		Lostwithiel			
		Loughborough			
240	25	*Louth*	25 0 0	6 0 0	26 10 0
		Lowestoft (see Beccles)			
611	5	Ludlow Union	5 0 0	6 0 0	5 0 0
		Luton			
		Lyme Regis			
		Lymington			
		Malmesbury			
		Macclesfield £20,000		4 13 5	
		Maidenhead			
250	50	Maidstone	50 0 0	10 0 0	100 0 0
		Maldon			
		Marlborough			
		Malton (New)			
		Manningtree			
		Mansfield £5000		10 0 0	
		March			
		Margate (see Isle of Thanet)			
		Market Deeping			
132	25	Market Harboro'	25 0 0	6 0 0	30 0 0
		Market Raisin			
		Market Weighton			
		Marlow			
370	10	Maryport	10 0 0	6 0 0	12 0 0
		Melksham			
		Melton Mowbray			
		Merthyr Tydvil			
		Mere			
		Middleton £5000			
		Midsummer Norton			
		Middlesboro'			
		Mildenhall			
		Mitcham			
		Mold			
700	10	Monmouth Gas and Water	10 0 0	4 0 0	
		Monk Wearmouth			
		Moreton in the Marsh			
		Morley			
		Nantwich			
		Neath			
		Needham Market			
		Newark £5000		10 0 0	
250	10	Newbury	20 0 0	5 0 0	20 0 0
13,000	5	Newcastle & Gateshead Union	5 0 0	10 0 0	6 12 6
		Newcastle-under-Lyne £5000		5 0 0	
600	5	Newmarket	5 0 0	6 0 0	5 0 0
		Newnham, Gloucestershire			
		New Mills & Hayfield £2115			
		Newport, Monmouthshire			
320	50	*Newport, Isle of Wight*	38 0 0	4 0 0	20 to 22
		Newport Pagnell			
		Newport, Salop			
		Newton Abbot			
		Newton, Lancashire			
		Northallerton			
		North Walsham			
		Northampton			
		Northwich			
		Norwich (see British Provincial)			
900	50	*Nottingham*	50 0 0	10 0 0	
900	50	New shares		10 0 0	
		Nuneaton			
		Oakham			
		Oakhampton			
200	10	Odiham, Hants	10 0 0		10 0 0
		Oldham			
		Ongar			
		Ormskirk			
		Otley, Yorkshire			
		Oundle			
		Oxford £18,000		9 10 0	
		Ocer Darwen £8000		5 0 0	
		Padstow			
		Pately Bridge, Yorkshire			
250	20	Penrith	15 0 0	6 10 0	21 0 0
		Penryn			
		Penzance			
200	10	Petworth	10 0 0	9 10 0	12 0 0
		Pickering			
3000	10	*Plymouth & Stonehouse*	10 0 0	6 0 0	11 0 0
		Pocklington			
		Pontefract			
400	10	Poole	10 0 0	5 0 0	10 0 0
		Port Madoc			
600	50	*Portsea Island*	53 0 0	5 0 0	47 to 49
400	10	Prescott	9 0 0	4 13 4	7 0 0
		Preston £52,500		10 0 0	
		Pwllheli			
		Pontypool			
		Pudsey			
		Radcliff and Pilkington £9000		4 12 10	
		Ramsay, I. of Man			
		Ramsgate (see Isle of Thanet)			
1000	10	*Reading*	10 0 0	3 0 0	7 0 0
500	20	Reading Union	20 0 0	6 0 0	17 0 0
		Redditch			
		Redruth			
		Reigate			
		Retford (East)			
		Richmond, Surrey			
		Ripon			
		Rochester and Chatham £14,000		6 0 0	
		Rochford			
		Rockingham			
		Ross			
		Rotherham £4000		10 0 0	
		Royston			
		Rugby			
		Rugeley			
		Ruthin			
		Runcorn			
500	10	Ryde	10 0 0	6 0 0	12 0 0
		Rye			
		Romsey			
		Saddleworth			
225	20	Saffron Walden	20 0 0	3 15 0	19 0 0
		St. Austel			
		St. Colomb			
		St. Helen's £7200		5 0 0	
		St. Ives, Hunting.			
		St. Ives, Cornwall			
		St. Neot's			
		Salisbury			
		Sandbach			
		Saxmundham			
		Scarborough			
		Selby			
		Settle			
290	10	Sevenoaks	10 0 0	5 0 0	10 0 0
		Shaftesbury			
5400	25	*Sheffield United*	24 0 0	8 6 4	32 0 0
		Shelton, Potteries (see British Provinces)			
		Shepton Mallet			
		Sherborne			
2914	5	Shields, North (Tynemouth)	5 0 0	3 0 0	5 0 0
		Shields (South)			
		Shiffnal, Salop			
		Shipley			
		Shipston-on-Stour			
		Shrewsbury £10,000		7 0 0	
400	10	Skipton	10 0 0	4 0 0	11 0 0
		Sleaford			
		Snaith			
		Soham			
		Southwold			
		South Molton			
1000	50	*Southampton*			
		Sowerby, Yorksh.			
		Stokesly			
		Stafford £10,000			
		Staines and Egham			
		Staley Bridge £15,000		10 0 0	
		Stamford £11,250			
		Stockton-on-Tees £3600		8 0 0	
840	9½	Stockton, New	9 10 0		8 0 0
960	10	Stoke-upon-Trent	10 0 0	6 10 0	12 0 0
500	10	„ new shares	3 0 0	6 10 0	5 0 0
		Stone, Stafford			
		Stoney Stratford			
		Stourbridge			
		Stowmarket			
150	20	Stratford-on-Avon	20 0 0	7 10 0	30 0 0
169	10	Stroud	10 0 0	5 0 0	5 10 0
		Swaffham			
		Swansea £9000			
		Sudbury			
6400	5	*Sunderland*, old	5 0 0		
		Sunderland, new			
2800	5	Swindon			2 10 0
		Taunton	5 0 0		
		Tadcaster			
		Tamworth			
		Tavistock			
		Teignmouth			
		Tenbury			
		Tenby			
		Tenterden £2000		2 10 0	
		Tetbury, Gloster			
		Tewkesbury			
		Thetford			
		Thirsk			
		Thornbury			
		Thorne			
		Tiverton			
670	5	Todmorden	3 0 6		
		Torquay			
		Torrington, Devon			
		Totness			
		Tottenham		6 0 0	
		Towcester			
		Tring			
		Trowbridge (see British Provin.			
75	50	Truro	50 0 0	2 0 0	
		Tunbridge			
		Tunbridge Wells			
		Ulverston			
		Uppingham			
		Usk, Monmouth			
		Uttoxeter			
		Uxbridge			
1000	25	*Wakefield*, old capl	25 0 0	6 0 0	24 0 0
1600	5	„ new „	5 0 0	6 0 0	4 16 0
300	10	Wallingford	10 0 0	5 0 0	8 0 0
		Wandsworth			
		Wantage			
		Warrington £18000		10 0 0	
100	10	Wareham	10 0 0	3 10 0	8 0 0
120	25	Warminster	25 0 0	5 0 0	27 0 0
		Warth			
		Warwick £15,000		6 0 0	
		Watford			
		Welchpool, Montgy.			
		Wellingborough			
		Wellington, Salop			
		Wellington, Smrst.			
		Wells, Smrst. £4000		6 0 0	
		Westbury			
		Weston-sup.-Mare			
2000	5	West Ham	5 0 0	6 0 0	5 0 0
		Whitby			
		Whitehaven			
		Whittlesea			
		Wigan £10,160		5 0 0	
		Willenhall			
		Winchelsea			
		Winslow			
240	10	Wimborne Minster	10 0 0		
		Wincanton			
		Winchester			
900	12½	Windsor	12 10 0	10 0 0	23 0 0
		Witham			
		Witney			
4448	10	*Wolverhampton*	10 0 0	7 10 0	11 10 0
		Woburn			
210	10	Wokingham	10 0 0		10 0 0
		Woodbridge			
		Wooler			
		Wotton-un.-Edge			
		Worcester			
		Workington			
		Worksop and Radford			
		Wirksworth			
		Worthing			
		Wrexham			
		Woolwich			
		Woolwich Consms.			
		Wymondham			
		Yarm			
795	20	Yarmouth	20 0 0		17 to 18
		Yeovil			
		York Untd. £55,000			
		SCOTLAND.			
		Aberdeen			
		Airdrie			
		Alloa			
		Anstruther			
		Ardrossan, nr. Saltcoats			
550	20	Arbroath	20 0 0	7 10 0	27 10 0
		Auchterarder			
		Auchtermuchty			
		Ayr, old (see Brit Provincial)			
		Ditto, new			
		Banff			
		Bathgate			
		Beith			
		Biggar			
300	6	Borrowstowness	6 0 0	5 0 0	8 0 0
		Brechin			
		Broughty Ferry, near Dundee			
		Burntisland			
		Campbelton			
		Clackmannan, near Alloa			
		Coatbridge			
		Coldstream			
		Collinsburgh			
		Crieff			
		Crail, Fife			
		Cumbernauld, near Glasgow			
600	5	Cupar Angus	5 0 0	6 0 0	5 10 0
250	10	Cupar Fife	10 0 0	7 10 0	14 0 0
		Dalkeith			
		Dingwall			
		Dumbarton			
400	20	Dumfries	14 0 0	5 0 0	20 0 0
		Dunbar			
		Dunblane			
		Dundee, old			
		„ new			
860	10	Dunfermline	10 0 0	6 0 0	12 12 0
		Dunkeld			
		Dunse			
		Dysart			
6000	25	*Edinburgh Gas Co.*	25 0 0	10 0 0	45 0 0
		„ *and Leith Co.* £150,000		6 10 0	
		Elie			
		Elgin			
		Falkirk, old			
		„ new			
		Falkland			
		Ferry Port on Craig, Fife			
		Forfar			
		Fort William			
		Fraserburgh			
		Galashiels			
		Girvan			
		Glasgow £122,500		5 0 0	
15000	10	*Glasgow City and Suburban*	9 0 0	7 10 0	9 0 0
		Grangemouth			
		Haddington			
		Hamilton			
		Hawick			
		Helensburgh			
		Inverary			
400	1	Inverkeithing	1 0 0	5 0 0	1 0 0
1200	10	*Inverness Gas and Water*	10 0 0	8 0 0	15 0 0
2400	5	„ new shares	1 5 0	8 0 0	2 5 0
		Irvine			

Number of Shares issued.	Amount per Share £	Name of Company.	Amount paid up per Share £ s. d	Dividend per Cent. per Ann. £ s. d	Price. £ s. d
		Jedburgh			
		Keith			
		Kelso			
		Kilmarnock			
		Kinghorne			
		Kingskittlo, Fife			
		Kinross			
		Kirkaldy			
320	5	Kirkcudbright	5 0 0	5 0 0	5 0 0
1000	3	Kirkintulloch, near Glasgow	3 0 0	5 0 0	3 0 0
227	5	Kirkwall	5 0 0	5 0 0	4 10 0
518	5	Kirriemuir	5 0 0	6 0 0	
		Lanark			
		Largo, near Leven			
		Largs			
		Lasswade, n. Edin.			
		Lauder			
		Leith			
		Leslie, Fife			
		Lesmahago			
		Leven			
		Linlithgow			
		Linton, n. Nobleh.			
		Lochee, n. Dundee			
		Lochgilphead			
		Lochwinnock, near Paisley			
1200	1	Markinch	1 0 0	7 10 0	1 5 0
		Mauchline			
		Maxwell-town, n. Dumfries			
		Melrose			
718	2	Mid & East Calder	2 0 0		2 0 0
192	5	Moffat	5 0 0		
		Montrose			
		Musselburgh			
		Nairn			
		Neilston, n. Glasg.			
		Newburgh, Fife			
		Newton Stewart			
		North Berwick, n. Haddington			
		North Queensferry			
		Oban			
		Peebles			
800	25	Perth	25 0 0	1 4 0	22 10 0
		Peterhead			
		Pittenweem			
		Pollokshaws, near Glasgow			
		Port Glasgow			
		Portobello, near Edinburgh			
		Prestonpans			
		Renfrew, n. Paisley			
		Saltcoats			
		Selkirk			
		South Queensferry			
		St. Andrew's			
		Stewarton			
		Stirling			
		Stonehaven			
		Stranraer			
		Strathaven, near Hamilton			
		Thurso			
		Tillicoultry, near Alloa			
800	1	Tranent	1 0 0		1 0 0
		Troon			
		Wick			
		Wigton			
		Wemyss		4 10 0	

Number of Shares issued.	Amount per Share £	Name of Company.	Amount paid up per Share £ s. d	Dividend per Cent. per Ann. £ s. d	Price. £ s. d
		IRELAND.			
300	10	Armagh	10 0 0	8 0 0	14 10 0
700	50	*Belfast*	50 0 0		
		Ballymena			
		Carrick-on-Suir			
		Carrickfergus			
		Cashel			
		Carlow, new			
		Cork (see United General)			
		Coleraine			
		Clonmel (see British Provincial)			
		Drogheda			
19,000	10	*Dublin Consumers*	5 0 0	6 0 0	5 0 0
		Dublin Hibernian (see United Gen.)			
160	25	Dundalk	25 0 0		22 0 0
		Dungannon			
		Downpatrick			
		Enniskillen			
		Galway			
400	10	Kilkenny	10 0 0	8 0 0	11 5 0
		Limerick (see U.G			
1725	5	Limerick Consum.	5 0 0	5 0 0	5 0 0
600	15	Londonderry	15 0 0	6 13 4	21 10 0
500	6¼	Lisburn	6 5 0	0 5 0	6 5 0
520	10	Lurgan	6 0 0	6 0 0	6 0 0
		Monaghan			
		Nenagh			
448	5	Newtownards	5 0 0	4 0 0	5 0 0
		Newry			
125	20	Portadown	13 0 0		
		Sligo			
		Waterford			
		Wexford			

The Gas Works in the undermentioned towns belong to private individuals:—

Carlow, old. Deal. Ely. Farsley. Gainsborough. Goole. Hertford. Holt. Huntingdon. Kingston-on-Thames. Lancaster. Lynn. Morpeth. Oswestry. Peterborough St. Alban's. Sandwich. St. Helier's, Jersey. Sheerness. Sidmouth. Sittingbourne. Stockport. St. Peter's Port, Guernsey. Spalding. Romford. Thame. Waltham Abbey. Ware. Wem. Weymouth. Whitchurch (Salop). Wisbeach.

The Gas Works belong to the Corporations, or to Commissioners acting under special acts of Parliament, in the following towns:—

Greenock. Keighly. Knaresborough. Manchester. Milton (Kent). Paisley. Rochdale. Rothesay. Richmond (Yorkshire). Salford. Strabane. Walsall. Wells (Norfolk).

*** We should feel greatly obliged by agents, or others interested, furnishing us with such corrections for our Share List as we may not have received through our usual channels of communication; our object being to present as accurate a list of prices as can be obtained; to procure which, we solicit the aid of correspondents in general.

Price Current.

The following List of Prices is corrected by an eminent wholesale house in each trade up to the latest period:—

CASTINGS, per Ton.

Average Weight of Cast Iron Pipes, per Yard.

1½ in.	2 in.	2½ in.	3 in.	4 in.	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.	12 in.
16	21	28	33	51	70	89	107	126	149	177	208 lbs.

Retail Prices are 5 to 10 per cent. higher.	London. £ s. d.	Glasgow £ s. d.	Newcastle. £ s. d.	Wales. £ s. d.	Yorkshire, Derbyshire, and Staffordshire £ s. d.
Pig Iron, No. 1	3 7 6	2 10 0	3 0 0	3 15 0	3 10 0
1½ and 2 inches Socket Pipes	6 0 0	5 0 0	5 10 0	5 15 0	5 15 0
2½ and 3 do. do.	5 17 6	4 17 6	5 7 6	5 12 6	5 12 6
4 and 5 do. do.	5 15 0	4 15 0	5 5 0	5 10 0	5 10 0
5 inches and upwards do.	5 12 6	4 15 0	5 2 6	5 7 6	5 7 6
Extra for bends, branches, and connection	2 0 0	2 0 0	2 0 0	2 0 0	2 0 0
Retorts, 1st fusion	5 2 6	..	..	4 17 6	5 0 0
Do. 2nd fusion	5 10 0	4 10 0	4 17 6	5 5 0	5 5 0
Tank Plates, ¾ thick and above	5 10 0	4 17 6	5 0 0	5 7 6	5 7 6
Do. less than ¾	5 15 0	5 0 0	5 5 0	..	5 10 0
Plain Castings ex. models	5 15 0	5 0 0	5 5 0	5 10 0	5 10 0

COALS.

NEWCASTLE. Unscreened.	s. d.
Tyne Main	5 6 per ton.
Ravensworth Pelaw, Dean's Primrose	5 9 „
Pelton, Medomsley, New Tanfield	6 0 „
Pelaw	6 3 „
Eighton Moor, Felling Main, Hutt's Tanfield, New Pelton, Peareth, South Pelaw, Waldridge, South Peareth, South Pontop	6 6 „
Ramsay's Cannel	15 0 „

DERBYSHIRE. Unscreened.	s. d.
Clay Cross, Deep Main, Jerries, New Birchwood, New Shipley, Sleight's, Soft Main	6 6 per ton.

SCOTCH CANNEL.		
Kirkness	best	23 0 „
Ditto	seconds	14 0 „
Lothian		18 0 „
Lesmahago		16 0 „
Wemyss		15 0 „
Dombristle		12 0 „
Lethans		
Bridgeness		11 0 „
Kinneil		
Lochgelly		10 0 „
Lumphunans		

FIRE GOODS.

Best Fire Bricks, 60s. per thousand, at Newcastle.
Do. Clay, 12s. per ton do.

WROUGHT IRON TUBING, subject to 25 per cent. Discount.

	2 inches. s. d.	1¼ inch. s. d.	1½ inch. s. d.	1 inch. s. d.	¾ inch. s. d.	½ inch. s. d.
Patent welded tubes, from 4 to 12 feet, per foot	1 8	1 0	0 10	0 7	0 5	0 4½
Ditto „ 2 to 4 feet	One penny per foot extra.					
Ditto „ 6 in. to 18 in., each	3 0	2 0	1 9	1 3	1 0	0 9
Connecting pieces, or long screws	3 6	2 3	2 0	1 6	1 2	0 11
Bends, wrought iron	3 9	2 3	1 9	1 0	0 10	0 8
Springs, wrought iron	3 9	2 3	1 9	1 0	0 10	0 8
Elbows, wrought or cast	3 9	2 3	1 9	1 0	0 10	0 8
Tees, wrought or cast	4 0	2 6	2 0	1 6	1 1	0 10
Crosses, wrought or cast	4 6	3 0	2 6	2 0	1 6	1 2
Iron cocks	17 6	9 6	7 6	4 6	3 3	2 6
Ditto, with brass plug	28 0	16 0	13 0	7 0	5 6	4 6
Diminishing sockets	1 3	0 9	0 8	0 6	0 5	0 4
Plain sockets	1 0	0 8	0 7	0 5	0 4	0 3
Caps, plugs, nipples, backnuts	1 3	0 9	0 8	0 6	0 5	0 4
Flanches	1 9	1 6	1 3	1 0	0 9	
Syphons, 2 quart	15 0	14 0	13 6	13 0	12 0	
Ditto 1 quart	11 0	10 0	9 6	9 0	8 6	
Tongs or nippers each pair	9 0	7 0	6 6	5 6	4 9	4 6
Elbow burners per dozen	7 6	jet or batwing.				
Straight burners „	6 0	ditto.				

Stocks, dies, and taps, for 2 inch, 1½ inch, and 1¼ inch tubing ..... £8 10s. 0d. per set.
Ditto, do. and do. „ 1 „ ¾ „ and ½ „ „ ..... 5 5 0 „
Ditto, do. and do. „ ¾ „ 2-8 „ and ¼ „ „ ..... 3 0 0 „

FREIGHTS, per Ton.

Coastwise—Newcastle.	s. d.
Chatham & Roches.	6 0
Colchest. & Maldon	6 0
Cork	9 6
Dartmouth	8 8
Devonport	8 8
Dover	6 6
Dublin	9 6
Exeter Quay	9 0
Faversham	6 6
Folkestone	6 6
Hastings	7 6
Ipswich	6 0
Jersey	9 0
London	6 6
Lowestoft	5 6
Lynn	6 0
Limerick	10 6
Margate	6 6
Newhaven	6 6
Portsmouth	8 3
Plymouth	8 0
Rye	8 6
Southampton	8 0
Totnes	8 9
Teignmouth	8 9
Weymouth	8 9
Yarmouth	5 9

Foreign.	s. d.
Amsterdam	10 0
Antwerp	8 4
Boulogne	7 6
Barcelona	18 0
Bordeaux	10 6
Calais	7 6
Caen	9 6
Cadiz	12 6
Christiana	8 0
Dieppe	8 6
Genoa	21 0
Hamburg	8 6
Havre	8 6
Leghorn	19 0
Lisbon	11 0
Marseilles	14 0
Nantes	12 0
Naples	20 0
Rotterdam	8 6
Rouen	11 6
St. Petersburg	15 0
Stettin	8 9
Toulon	17 0
Trieste	22 0
Venice	22 0